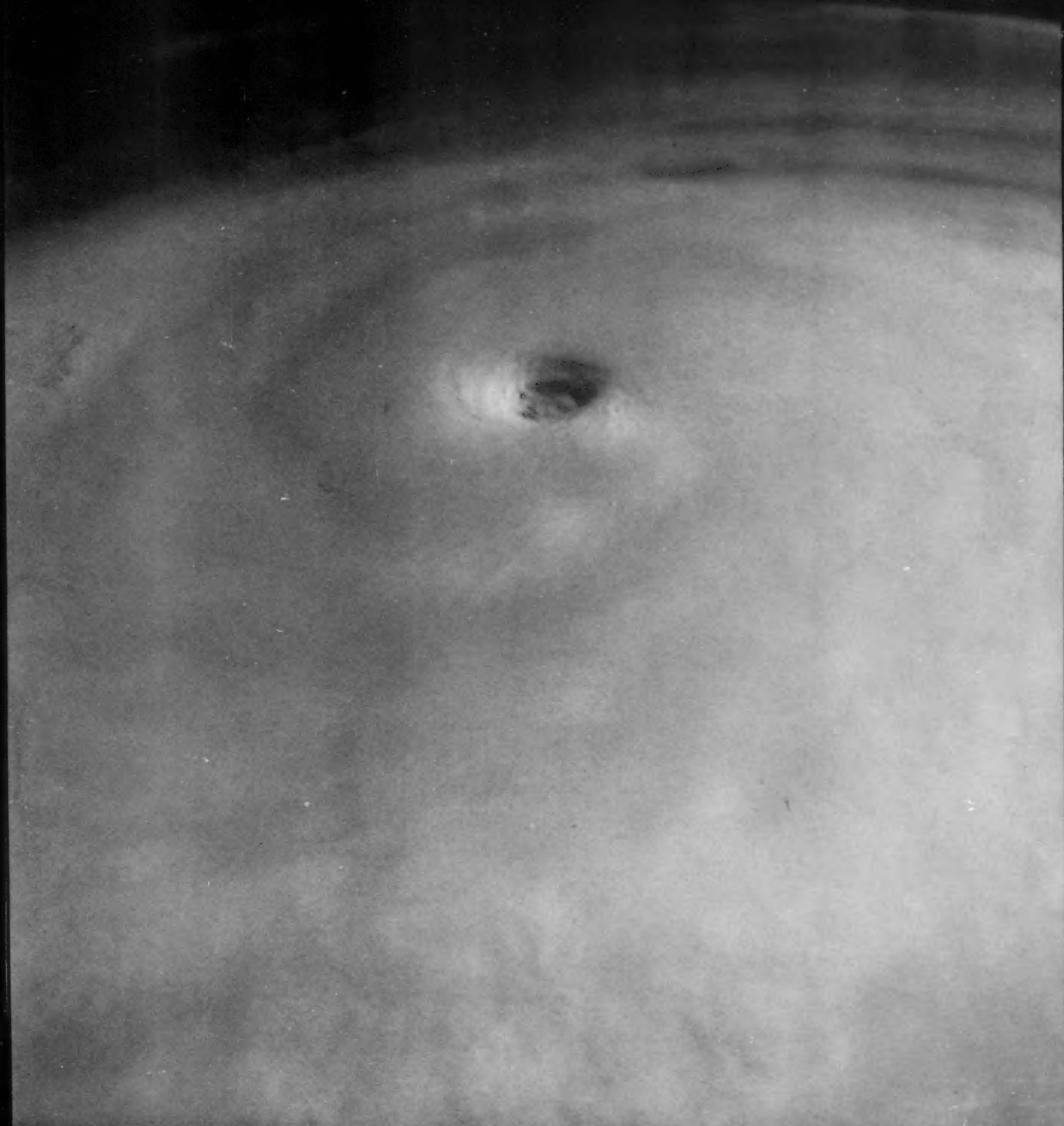
Mariners Weather Log

Spring 1992



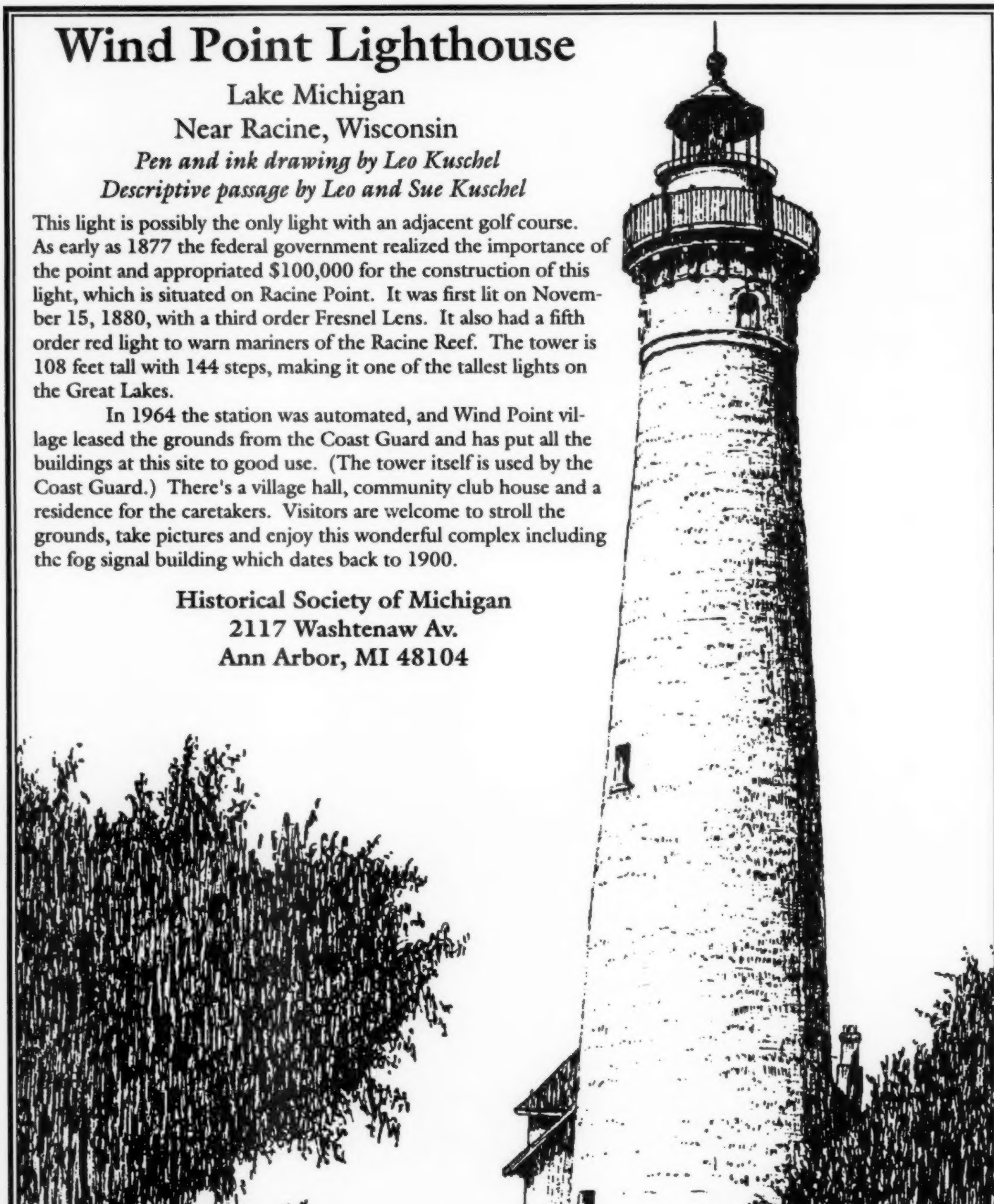
Wind Point Lighthouse

Lake Michigan
Near Racine, Wisconsin
Pen and ink drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel

This light is possibly the only light with an adjacent golf course. As early as 1877 the federal government realized the importance of the point and appropriated $100,000 for the construction of this light, which is situated on Racine Point. It was first lit on November 15, 1880, with a third order Fresnel Lens. It also had a fifth order red light to warn mariners of the Racine Reef. The tower is 108 feet tall with 144 steps, making it one of the tallest lights on the Great Lakes.

In 1964 the station was automated, and Wind Point village leased the grounds from the Coast Guard and has put all the buildings at this site to good use. (The tower itself is used by the Coast Guard.) There's a village hall, community club house and a residence for the caretakers. Visitors are welcome to stroll the grounds, take pictures and enjoy this wonderful complex including the fog signal building which dates back to 1900.

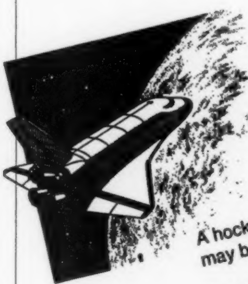
Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104

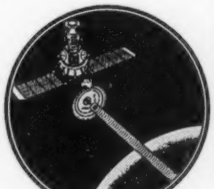


Spring 1992

Vol. 36, No. 2

Mariners Weather Log





A hockey player in space looks at what may be a losing battle, on page 48.

Satellite expert Jenifer Clark hosts a new column, on page 36.

Cover: Astronaut Mario Runco presents a meteorologist's view of Super Typhoon Yuri. Photo courtesy of NASA.

Back Cover: Back on earth, Great Lakes weather can be quite photogenic as in this Lake Superior scene by photographer Tom Buchkoe.

Centerfold: Super Typhoon Yuri one more time—it isn't often that mariners get a tranquil view of a typhoon, but NASA was kind enough to share these beautiful shots. This was taken on November 28, 1991 at about the time of the typhooon's peak intensity.

Paul Bradley's view of one of the two Block Island lighthouses— Page 30.

Departments

Marine Weather Review

October, November and December 1991

Mariners Weather Log

Editor
Richard M. DeAngelis

Columnists
Elinor DeWire
Marty Baron
Michael Halminski
Jenifer Clark

Computer Specialist
Gary Keull

Word Processing
Shirley Patterson

U.S. Department of Commerce
Barbara Hackman Franklin, Secretary

National Oceanic and Atmospheric Administration
Dr. John A. Knauss, Administrator

National Environmental Satellite, Data, and Information Service
Thomas N. Pyke Jr., Assistant Administrator

National Weather Service
Elbert W. Friday Jr., Assistant Administrator

National Oceanographic Data Center
Bruce C. Douglas, Director

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July l, 1992.

The *Mariners Weather Log* (ISSN:0025-3367) is published quarterly by the **National Oceanographic Data Center**, National Environmental Satellite, Data, and Information Service, NOAA, Washington DC 20235 (telephone; 202-606-4561). Funding is provided by the National Weather Service, NOAA. Data is provided by the **National Climatic Data Center**, NOAA. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402.

Articles, photographs and letters should be sent to:

Editor, Mariners Weather Log
National Oceanographic Data Center
1825 Conn. Av., NW
Washington DC 20235.

The Golden Eagle and Other Goofs

After 35 years of publishing, we have learned that no one is immune to typographical errors and other blunders. They are part of what you accept as an editor, unless you work for National Geographic, where proofreading is a religion. Desktop publishing has been a godsend, with spell-checkers and even grammar checkers, however, as most everyone who uses a computer knows, they can't think for you.

Last issue we published a piece by Bob Novak, PMO in the San Francisco Bay Area. The photographs came out well and his experience with the California Maritime Academy cadets was interesting. However, somehow we (I) decided to rename their vessel the ***Golden Bear***, the Golden Eagle. I don't know why but that's how the title came out. My apologies to Captain Keever and the cadets at the California Maritime Academy. Maybe in the future we will have a Golden Eagle award presented for the best typo.

Many years ago, when we were strictly a cut-and-paste outfit, we ran a column called the Marine Weather Diary. For about six issues we ran it as the **Marine Weather Dairy** in bold type no less. It wasn't until Rob Quayle of NCDC brought it to our attention that it was corrected. While I am confessing to goofs, I would also like to apologize to Jerry Bielicki, whose name was misspelled for several issues. Jerry is a contributing Great Lakes photographer whose photographs have gone a long way toward improving the quality of the Log. An example of his fine work appears in the advertisement on page 41 of this issue. We will end this confessional with a short poem by Robert P. Anderson, sent in by the aggrieved Bob Novak.

TYPOS

Robert P. Anderson

The typographical error,
Is a slippery thing and shy,
You can hunt it 'til you're dizzy,
But it somehow will get by.

'Til the forms are on the press,
It is strange how still it sleeps,
It shrinks down in a corner,
And it never stirs or peeps.

The typographical error,
Is too small for human eyes,
'Til the ink is on the paper,
When it grows to mountain size.

The boss just stares in horror,
Then grabs his hair and groans,
The copy reader drops his head,
Upon his hands and moans.

The remainder of the issue,
May be as clean as clean can be,
But the typographical error,
Is the only thing they'll see!

NOS Knows Alaska

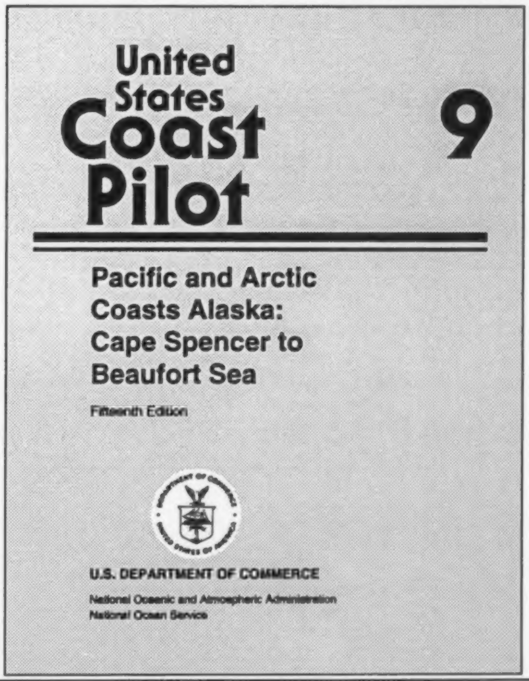
©1989, UNIPHOTO, Inc.

The National Ocean Service Coast Pilot

This series of nine nautical books covers a wide variety of information important to navigators of U.S. coastal and intracoastal waters, and the waters of the Great Lakes. This is information that cannot easily be shown on standard nautical charts and includes but is not limited to:

- channel descriptions
- anchorages and pilotage
- bridge and cable clearances
- currents and ice conditions
- tide and water levels
- weather and climate
- dangers and prominent features
- routes and traffic separation schemes

FOR SALE BY NOS AND ITS AGENTS
Distribution Branch (N/CG33)
National Ocean Service
Riverdale, MD 20737-1199



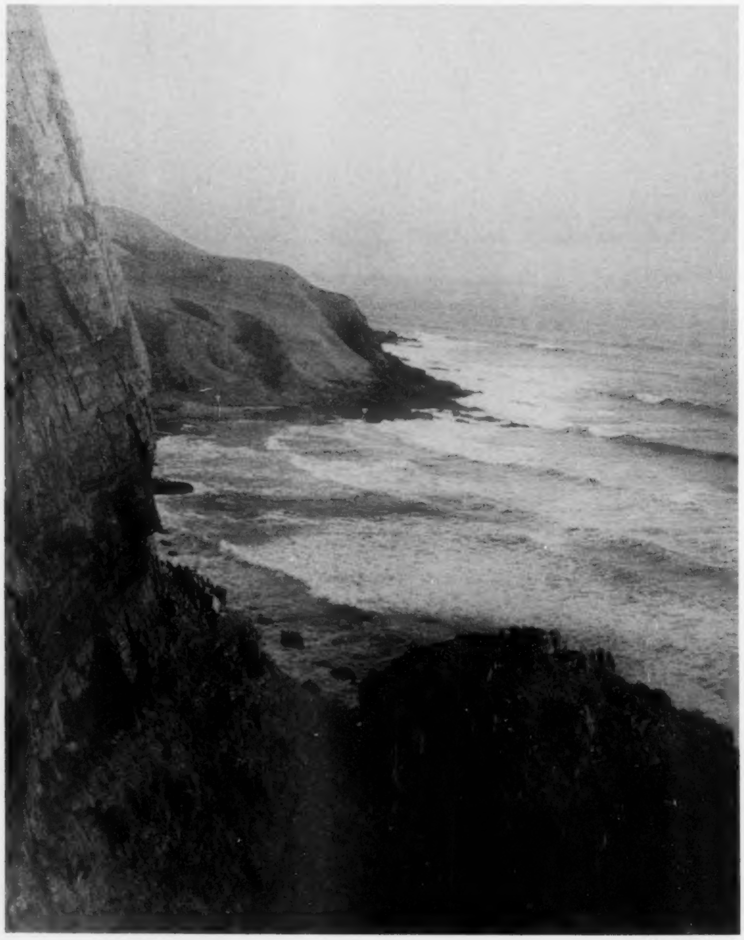
In a courageous battle against the sea it was South Africa 571 — Indian Ocean 0

Oceanos' Heroes

PA3 Howard J. Holmes

Everything was in place for a major maritime disaster on the night of August 3, 1991. The cruise ship *Oceanos*, with 571 people aboard, was foundering in storm force winds and 24-foot seas, 2 miles off a rocky, deserted South African shore, known as the *Wild Coast*. Only the combined, heroic efforts of South African military and civilian personnel, tour people aboard the *Oceanos* and merchant crewmen from nearby vessels prevented the loss of even a single life.

The *Oceanos* was just one of several vessels caught in the storm that generated huge dangerous swells known to mariners the world over as *Cape Rollers*. The 7,554-ton ULCC *Mimosa*, fully laden with Arabian crude, ran into 60-foot waves and suffered a 2300-square foot gash in her side after a steering connection fractured, some 25 miles east of Port Elizabeth. The weather chart this night was remarkably similar to



Ken Gerhardt

The Transkei Coast is located between East London and Durban and is nicknamed the Wild Coast. At left, the early morning sun lights up the cliffs near Mapuzi Point. It is near here that the **Oceanos** *went down and this coast presented a major difficulty in planning the rescue. The* **Oceanos** *(right) was being assisted by the helicopters when this photograph was taken. The ship's list plus the rough seas made it impossible for them to land.*

Howard J. Holmes is a member of the U.S. Coast Guard and Assistant/Managing Editor for the AMVER Bulletin. His article originally appeared in the AMVER Bulletin No. 3-91. This is an expanded version of that article and we are grateful to the Coast Guard for sending it in.

Additional details for the story were kindly provided by Commander Yegan S. Moodley, Assistant Military and Naval Attaché, Embassy of South Africa in the U.S., and Ian Hunter, Deputy Director, Marine Meteorology, South African Weather Bureau. Storm details can be found in Ian Hunter's column on page 38.

Wide World

that of May 17, 1974 when the Norwegian tanker ***Wilstar*** lost most of her bulbous bow to a *Cape Roller*.

The first, faint distress signal from the ***Oceanos*** was received at 11:16 p.m. (local time) by Port Elizabeth's radio control tower. Duty personnel at the Rescue Coordination Center (RCC) in Silvermine (the South African Defence Force combined force Southern Air Command Centre) monitored the exchange of communication between Port Elizabeth and Durban with mounting concern. An RCC member on duty contacted Brigadier Theo de Munnink– CO of the Southern Air Force Command Post, based in Pretoria. The information he received was sketchy– a large passenger vessel was in distress off the notorious Transkei Coast. Within minutes Brigadier de Munnink launched one of South Africa's biggest and most ambitious search and rescue operations.

The South African Air Force deployed 16 aircraft with a Mobile Air Operations Team. The South African Navy immediately sent out four strike craft and 31 divers. A temporary helicopter base was set up in Coffee Bay (on the Transkei Coast), where survivors could be off-loaded and treated. A Navy broadcast requested all nearby vessels to proceed to the Oceanos' location.

By 1:00 a.m., Durban, South Africa, established and maintained communications with the ***Oceanos***. After the ships' captain and radio officer abandoned ship, a member of the ship's entertainment troupe took control of the radio and informed Durban that two life-boats, filled with survivors, were launched, but they were having difficulty in launching the remaining boats. They did

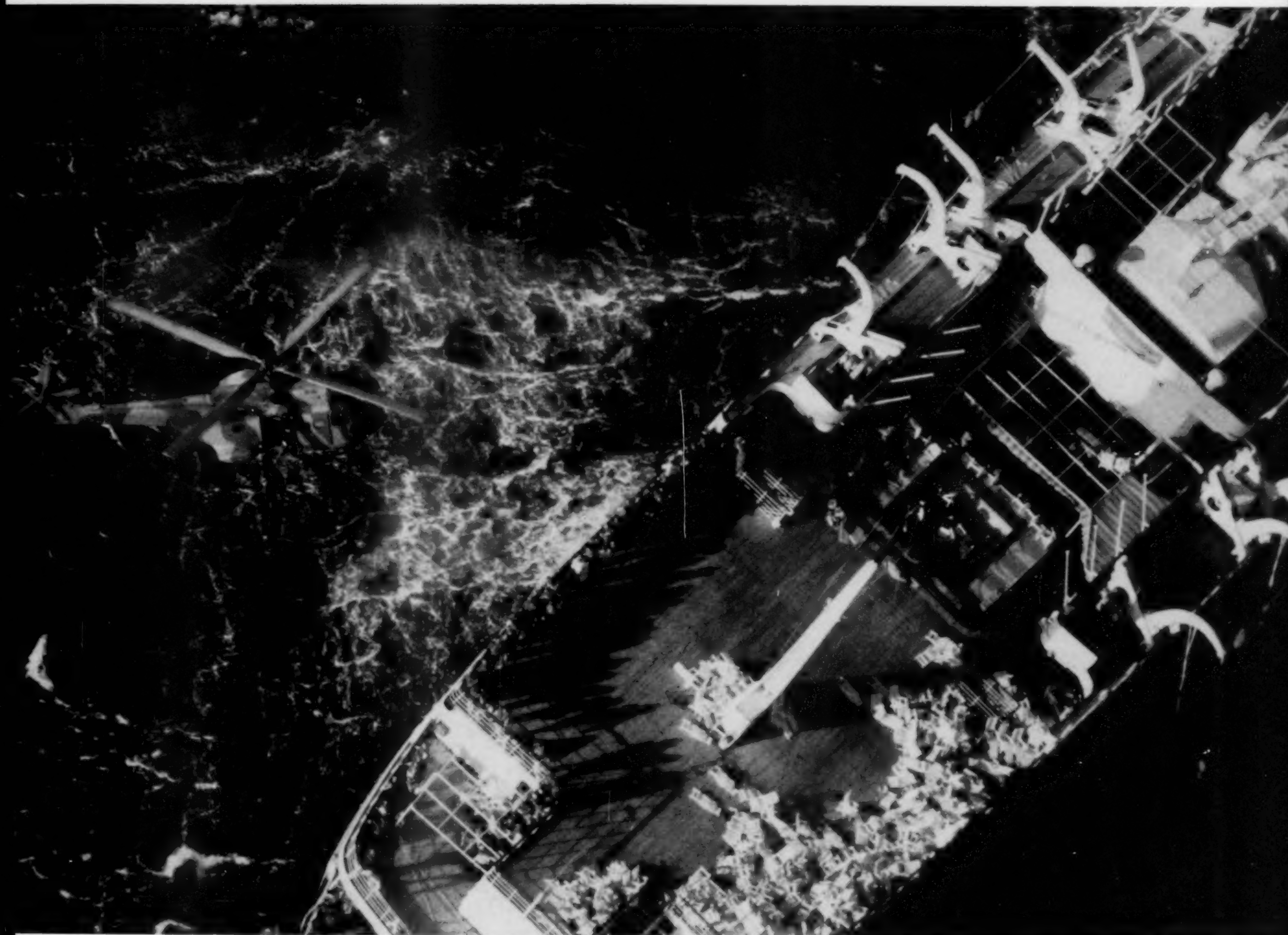
manage to launch all eight lifeboats as well as inflatable liferafts. Miserable weather conditions aside, the biggest obstacle, initially, was the distance rescue aircraft needed to travel before arriving on the scene.

A C-160 aircraft flew over the area at 6:00 a.m., but was limited by darkness. By 6:15 a.m., the first merchant vessels arrived and began pulling survivors from lifeboats. The helicopters arrived at The Haven (a seaside holiday resort) at sunrise. They then proceeded to drop a team of divers onto the heavily listing ship, which was pitching violently in 25- to 30-foot swells, while the helicopters were being buffeted by winds in excess of 50 knots. By this time, the ***Oceanos*** had a 30-degree list, so its helicopter deck was unusable.

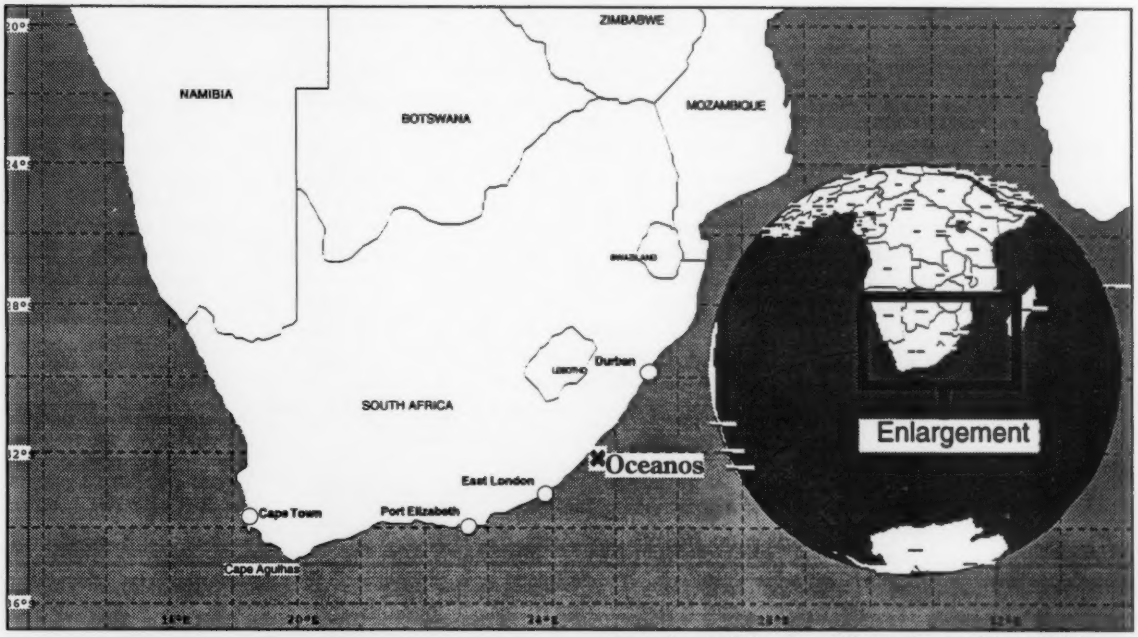
The merchant vessels that participated included the ***Nedlloyd Mauritius***, ***Anik***, ***Reefer Duchess*** and a Soviet vessel the ***Great Dancy***. Heavy swells and force six winds, kept these ships from getting close enough to assist stranded victims. The disabled ship continued to take water at an alarming rate as 225 passengers waited onboard.

The South African Broadcasting Corporation requested small craft to assist in searching the area between the ***Oceanos*** and the shoreline. The National Sea Rescue Institute, a part-time volunteer organization, took over this risky operation. Meanwhile the C-130 crew members dropped liferafts and smoke markers, by hand, from the plane's cargo ramps.

Prior to the ***Oceanos*** sinking, the team of divers swept through the vessel to check for passengers still below. One diver found a crippled, old man and carried him out to the helicopter winching area. Another diver, while launching a Zodiac dinghy, was sucked toward the Oceanos' propeller and then flung clear with a gash in his wet



Wide World



On page 6, the passengers aboard the Oceanos line the aft port rail waiting to be hoisted by rescue helicopters. Later, a South African Navy mine countermeasures vessel the SAS ***Umkomaas***, *conducted a survey of the wreck. A sonar picture showed the Oceanos lying on her starboard side in about 300 feet of water with the hull intact and no holes or structural damage. She was no danger to navigation. The vessel sank just before 2 p.m. (below). The ABC News photo was provided by the Associated Press.*

ABC News

The Unlucky 4th of August

Exactly 210 years ago to the day an incident similar to the Oceanos sinking took place. On the 4th of August 1782, the Grosvenor, an English East Indiaman, on a return voyage from the East was wrecked on the Pondoland coast after being battered by mountainous seas for days.

The vessel was close inshore seeking safer water. Tragically, on that fatal day she was too close and the raging seas hurled her onto the jagged coast. Efforts to launch lifeboats proved futile as they were instantly smashed on the rocks. Such was the pounding sea that the once proud vessel was wrenched in two. The stern section, the refuge of most of those onboard, was driven closer to the shore. As terrifying as this experience was, it made it possible to rig a lifesaving cable from the stern to the shore. This was achieved with the help of the Pondo people. One hundred and fifty people survived this death defying ordeal only to begin another.

The party, which included members of the British aristocracy, began a march to the Cape. Of this ill-fated and ill-prepared party, only nine reached civilization. Many died from disease and exhaustion. Others were either killed or kidnapped. A rescue expedition later found four more survivors. The Grosvenor carried a treasure worth millions of pounds, including gold pieces and precious stones, all of which were lost.

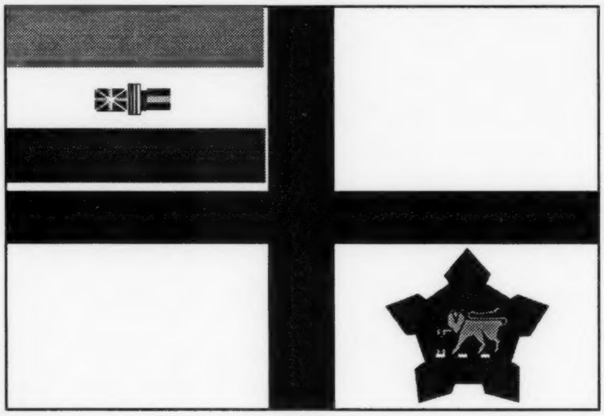
suit as a memento of his brush with death. A passenger trying to hang on to his video camera, while being hoisted, slipped out of the harness and fell face first into the tumultuous sea. Paul Whiley, the diver who saved the old man, jumped from the equivalent height of a 9-story building and hauled the shaken man into a rescue boat.

According to Brigadier de Munnink, the South African Air Force did a "fantastic job" as more than 200 people were airlifted to shore. Passengers in the lifeboats were rescued by merchant ships and South African Navy vessels in the vicinity. A croupier, who had loaded his pockets from the gaming tables and jumped into the water, sank quickly and had to undo his pants to keep from drowning. He was picked up some 8 miles downstream.

By noon on the 4th, the *Oceanos* was listing 70 degrees to starboard and shipping tons of water as massive swells broke across her bow. Just before 2 p.m. her stern lifted as the bow and superstructure slipped beneath the sea.

Upon the sinking of the *Oceanos* all 225 people originally stranded on the decks of the ship were accounted for. However, 15 passengers remained missing but were later found to have been picked up by merchant ships. Because of the heroic efforts of all responding parties, all 571 of the Oceanos' crew and passengers were saved. The last survivors were rescued when a diver helped the captain's dog and opened a cage to allow the captain's canary to fly the coop. This action completed the rescue mission onboard.

South Africa Summary



According to Commander Yeagan Moodley, Assistant Military and Naval Attaché, Embassy of South Africa in the U.S., although no loss of life occurred, rescue efforts were hampered in several ways. The following hindrances in rescue capabilities, that, if not overcome, could have led to catastrophic results:

- Lack of specialized maritime "on-scene search and rescue aircraft." This hampered the ability to deliver survival equipment to endangered victims.
- Limited links to international and rescue organizations, and limited ability of photography and communications hampered coordination. This made the search for individuals washed from the scene less than effective.
- Lack of suitable search and rescue helicopters: This was highlighted in the ability to hoist only two survivors at a time.
- Lack of suitable naval vessels for search and rescue. This has been a problem since the South African Navy was forced to retire its last remaining frigates.

Fortunately for the survivors, the South African rescue efforts overcame these obstacles and performed superbly in effecting this spectacular rescue.

Just weeks after the Oceanos rescue, South African Air Force Col. George Hallowes, the Oceanos rescue coordinator, paid a visit to the U.S. Coast Guard RCC, and the AMVER Center, on Governors Island New York. Hallowes briefed the Coast Guard Atlantic Area Commander's staff leaders on rescue efforts and operations and praised individuals and responding vessels for their excellent performance during the rescue.

Hallowes lavished particular praise on South African Air Force Sgt. Kate Matthewson. "Sgt. Matthewson did a miraculous job while on watch during this incident," Hallowes said. "She used her own initiative to overcome the many problems that arose." Hallowes noted that all merchant vessels involved were "extremely cooperative and professional." He specifically cited the M/V Nedlloyd Mauritius.

He also recommended a magician, who was part of the ship's entertainment, for South Africa's highest civilian award. The magician took charge of the ship's communications after the captain and radio officer abandoned ship.

A major problem after the rescue was matching names of survivors with the ship's manifest, because some passengers used false names to cover romantic affairs.

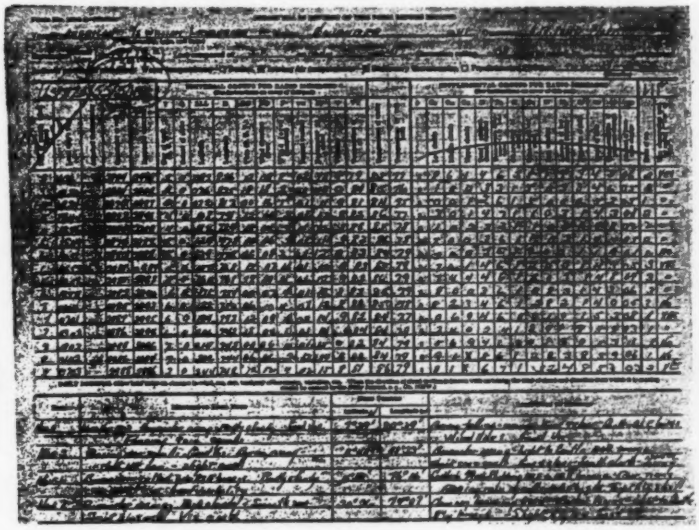
His visit provided an effective exchange of knowledge and experience in search and rescue procedures. The value of resources, such as the AMVER surface picture, in a disaster of this magnitude was also discussed. This case also emphasizes the value of ships on the AMVER plot allowing the quickest most effective response to disasters of this magnitude.

WANTED DEAD OR ALIVE

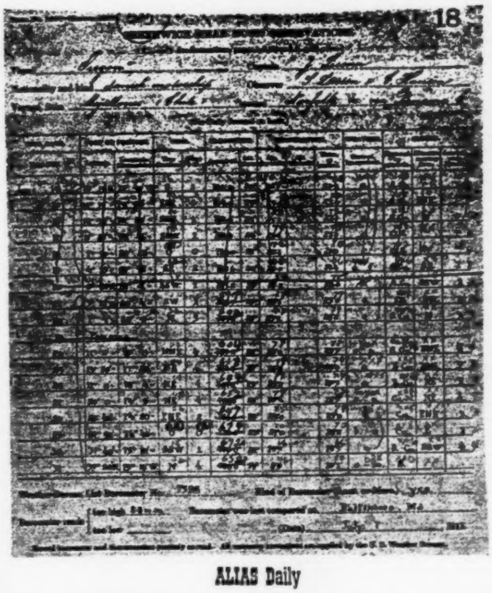
Hourly, AKA Daily AKA Synoptic

These U.S. merchant marine observation forms from the 1940s go by three names: ***daily*** *(one observation per day);* ***synoptic*** *(generally two observations per day); and* ***hourly*** *(generally 3 to 5 observations per day). Daily is by far the most likely to be seen. Daily forms record only the Greenwich Mean Noon observation each day. This requirement was established in order to produce one large-scale synoptic chart per day, assuming it to be the most beneficial aid to the mariner in determining the most probable weather to be encountered.*

If the whereabouts of any of these forms is known please call Joe Elms at 254-672-0344 or write National Climatic Data Center Federal Buidling Ashveille, NC 28801



Hourly



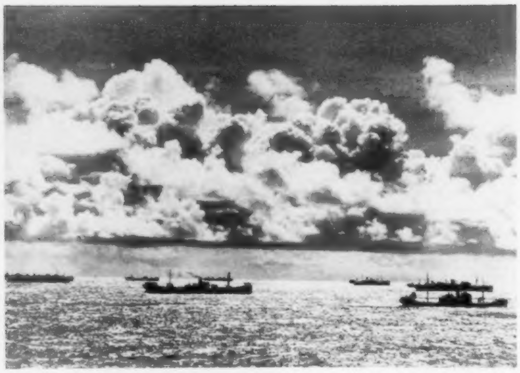
ALIAS Daily

ALIAS Synoptic

Although some 50 years have passed since World War II, there are still some unanswered questions, including

WHERE HAVE ALL THE DATA GONE?

JOE D. ELMS, ROBERT G. QUAYLE AND SCOTT D. WOODRUFF



"Modern Meteorology really came of age during the Second World War. For it soon became obvious that success in this war, more than any previous war in history, would often depend on whose side the weather was on."

–Patrick Hughes, from ***A Century of Weather Service.***

Convoys were a way of life for merchant ships during World War II, which undoubtedly resulted in many duplicate weather observations. Observations from the Navy ships did get into the system and were digitized early. However, there are wide gaps in the ocean climate picture for the 1940s that need to be filled, and the only hope are the records from some of the merchant ships during the war and even a year or two after it. Above, a convoy of merchant ships, under a tropical sky, in the Caribbean is viewed from the SS ***William J. Worth*** *in September of 1943. A merchantman steams through stormy North Atlantic seas (right) as seen from the escorting USS* ***Greer*** *in June of 1943. Also in June 1943, a convoy of LSTs runs into heavy weather in the North Atlantic while enroute to South Africa to take part in the Sicilian Campaign. These are all U.S. Navy Photos and they were kindly provided by the Naval Imaging Command with assistance from the Naval Historical Center.*

Joe Elms and Rob Quayle are meteorologists at NOAA's National Climatic Data Center in Asheville, NC, while Scott Woodruff is a computer specialist at the NOAA Environmental Research Laboratories in Boulder, CO. They are seeking assistance in retrieving or determining the fate of the merchant marine weather observations from the period 1941–1946. If anyone has a clue as to what happened to any of these observations, please get in touch with one of the three, through the Mariners Weather Log.

The SS Coulmore (left) was caught in a storm in the Atlantic in 1943. In February of 1942, the Germans used squally, foggy weather to cover the escape of the battleships **Gneisenau** *and* **Scharnhorst** *from Brest and screen their subsequent flight northward through the English Channel. German U-boats took advantage of poor weather and sea conditions in the Atlantic in an attempt to sever the marine lifeline to Europe.*

U.S. Navy

Before World War II, climatology mostly meant weather averages, extremes and totals. Suddenly, there was a demand for long range weather probabilities for planning amphibious landings and other military operations.

In October of 1941 a joint Army-Navy-Weather Bureau project was undertaken to add additional ship observations to the Northern Hemisphere surface charts to assist in this planning. By early 1944 Allied meteorologists had a series of charts dating back to 1899, which they were able to use in several important operations.

In an ironic twist of fate, there is now a similar push for marine weather observations, which were taken by merchant ships during World War II, to assist researchers today who are looking at the important issue of climate and global change.

Weather has always played a crucial role in the lives of mariners, often determining their fate at sea. Would there be enough wind to sail that day? Would they eventually reach their destination? Could they survive the approaching storm? Where were the best routes to avoid the worst of the weather and make the best time?

A very early application of marine weather knowledge was the wind-rose. This was a circular card in the shape of a compass card on which were drawn the direction of certain named winds. It is not known just how old these cards are, but, by the time of Homer, around 900 B.C., Greek seamen were using four named winds as their principal means of navigation. Later, as voyages became longer, more winds were added to the card for more accurate navigation.

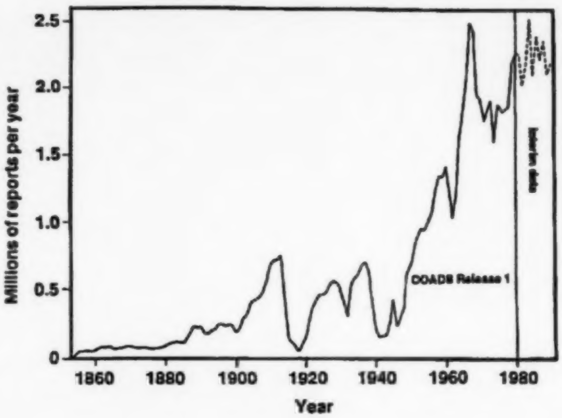
An early Compass Card, circa 1750

However, many of the early marine weather observations were very descriptive:

"The cloudes gathering thicke upon us, and the windes singing and whistling most unusually... a dreadful storme and hideous began to blow out of the northeast, which swelling and roaring as it were by fits, some houres with more violence than others, at length did beate all light from Heaven; which like a hell of darkenesse turned black upon us, so much fuller of horror, as in such cases horror and feare overrunne the troubled and overmasted senses of all."

—Marine weather observation by William Strachey aboard the *Sea Venture* in 1605.

The story of the shipwreck of the ***Sea Venture***, which was on its way to replenish the early British settlement at Jamestown, Virginia was the inspiration for *The Tempest* by William Shakespeare.



If this were the game show Jeopardy and the category was weather,and the answer read–something the U.S. has more of from 1885 than from 1942, the correct question might be–What are marine weather observations?

One of the early attempts to bring some degree of objectivity into marine weather weather reports was the Beaufort scale. In 1805, Lieutenant Francis Beaufort of the British Navy assigned numbers to a descriptive wind scale and letters to the weather conditions, thus making it easier to standardize the observing practices and pass along the information to others. Even today the Beaufort scale is frequently used to estimate wind speeds, even though the reporting units are knots or meters per second. In the mid-1800's, an American, Lieutenant Matthew Fontaine Maury, as Superintendent of the Depot of Charts and Instruments, used ship reports to produce climatological summaries to aid to navigation. His success led to an International Conference held in Brussels in 1853, which produced some uniformity in coding observations and increased international cooperation among the maritime nations.

The ensuing wealth of weather observations recorded by mariners has been used for climatologies, diagnostic climate research (e.g. El Nino events), aids to navigation, and ground-truth reference for satellite and buoy observations.

Unfortunately, the present archive of digitized U.S. merchant marine data available to scientists does not start until 1948–decades after the introduction of systematic observing practices. In fact, entering data onto punch cards began around the turn of the century with the introduction of the Hollerith system by the U.S. Navy.

By the mid 1960's, the National Climatic Data Center had collected 17 differently-formatted marine data sets from various maritime nations. A series of climatic atlases was produced from these data covering all oceans of the globe. The original punched cards were placed on magnetic tape and converted into a common format around 1968. After the 1968 consolidation, the original data were updated and quality controlled, and a revised set of atlases (excluding the Arctic and Antarctic) was produced in the 1970's. This so-called "atlas data set" then became the core of the Comprehensive Ocean-Atmosphere Data Set (COADS) Release 1, which expanded the data base, produced global statistics for 2 x 2 degree quadrangles (year-month summaries) and provided extensive documentation– a far cry from Maury's original charts.

Inventories produced for the COADS project showed that relatively few digitized data were available for the two World Wars. Considering the present importance of climate and global change and the substantial impact that the oceans have on the global climate it is important to try to fill these data gaps. So, an integral part of the on-going COADS update project includes finding or accounting for the missing data.

The National Climatic Data Center (NCDC) in close cooperation with the NOAA Environmental Research Laboratories' Climate Research Division (ERL/CRD) and the National Center for Atmospheric Research (NCAR), is digitizing manuscript ship observations found in the U.S. National Archives in an effort to enhance the twentieth century time series. Approximately 2.5 million undigitized ship weather reports have been unearthed in the National Archives for the period 1912–1946, but very few of these were taken between 1942 and 1946. NCDC is digitizing these records at a rate of approximately 80,000 reports per month. In an effort to save as much detail as possible, about 20 different formats are being used.

One possible explanation for the missing data is that U.S. Merchant Marine observations were declassified at the end of the war and returned to each ship's parent shipping company where the original forms were eventually destroyed. If anyone has any knowledge regarding the disposition of these valuable records, the authors would certainly appreciate such information, as efforts are still underway to locate (or at least document) the disposition of these historical records.

The COADS consortium (CRD, NCAR, and NCDC) will pro-

Atlases Produced From Merchant Marine Observations

U.S Navy, Chief of Naval Operations, 1955: U.S. Navy Marine Climatic Atlas of the World, Volume I, North Atlantic Ocean, NAVAER 50-1C-528.

U.S Navy, Chief of Naval Operations, 1956: U.S. Navy Marine Climatic Atlas of the World, Volume II, North Pacific Ocean, NAVAER 50-1C-529.

U.S Navy, Chief of Naval Operations, 1957: U.S. Navy Marine Climatic Atlas of the World, Volume III, Indian Ocean, NAVAER 50-1C-530.

U.S Navy, Chief of Naval Operations, 1958: U.S. Navy Marine Climatic Atlas of the World, Volume IV, South Atlantic Ocean, NAVAER 50-1C-531.

U.S Navy, Chief of Naval Operations, 1959: U.S. Navy Marine Climatic Atlas of the World, Volume V, South Pacific Ocean, NAVAER 50-1C-532.

U.S Navy, Chief of Naval Operations, 1963: U.S. Navy Marine Climatic Atlas of the World, Volume VI, Arctic Ocean, NAVWEPS 50-1C-533.

U.S Navy, Chief of Naval Operations, 1965: U.S. Navy Marine Climatic Atlas of the World, Volume VII, Antarctic Ocean, NAVWEPS 50-1C-50.

U.S. Navy, Naval Weather Service Command, 1974: U.S. Navy Marine Climatic Atlas of the World, Volume I, North Atlantic Ocean (Revised), NAVAIR 50-1C-528.

U.S. Navy, Director Naval Oceanography and Meteorology, 1977: U.S. Navy Marine Climatic Atlas of the World, Volume, II, North Pacific Ocean (Revised), NAVAIR 50-1C-529.

U.S. Navy, Naval Weather Service Command, 1976: U.S. Navy Marine Climatic Atlas of the World, Volume III, Indian Ocean (Revised), NAVAIR 50-1C-530.

U.S. Navy, Director Naval Oceanography and Meteorology, 1978: U.S. Navy Marine Climatic Atlas of the World, Volume IV, South Atlantic Ocean (Revised), NAVAIR 50-1C-531.

U.S. Navy, Commander Naval Oceanography Command, 1979: U.S. Navy Marine Climatic Atlas of the World, Volume V, South Pacific Ocean (Revised), NAVAIR 50-1C-532.

cess the data for the COADS Release 2 update. It will include the U.S. merchant ship data, buoy observations, oil platform reports, Navy and research vessel reports, additional historic data from foreign sources, and possibly additional data such as the Maury Collection (1820-1860) and Japanese data from the Kobe Observatory Collection that resides on microfilm at NCDC (1892-1933). In regards to the Kobe Collection, we must first ensure that it has not already been digitized by Japan or some other nation. If it is established that these early Kobe data do not reside in any digital archive, then it is important that they be digitized because of the frequency of reports (generally 6 to 8 per day), routes traveled, and the data coverage during the data-sparse years.

The target date for completing the COADS Release 2 update is 1994, but many tasks lie ahead before completion. COADS has developed into a large international cooperative project with additional data, beyond the established exchange agreements of marine data under WMO Resolution 35, being provided by many maritime nations. Past inconsistencies in the data are being corrected, previously undigitized data are being keyed, large data sets are being provided to researchers for comparative studies, and a significant amount of background information is being collected to establish better documentation. Upon completion of Release 2, COADS should be the most complete digital marine data set available in the world. With accompanying statistics, it will provide valuable information for researchers and other practical applications.

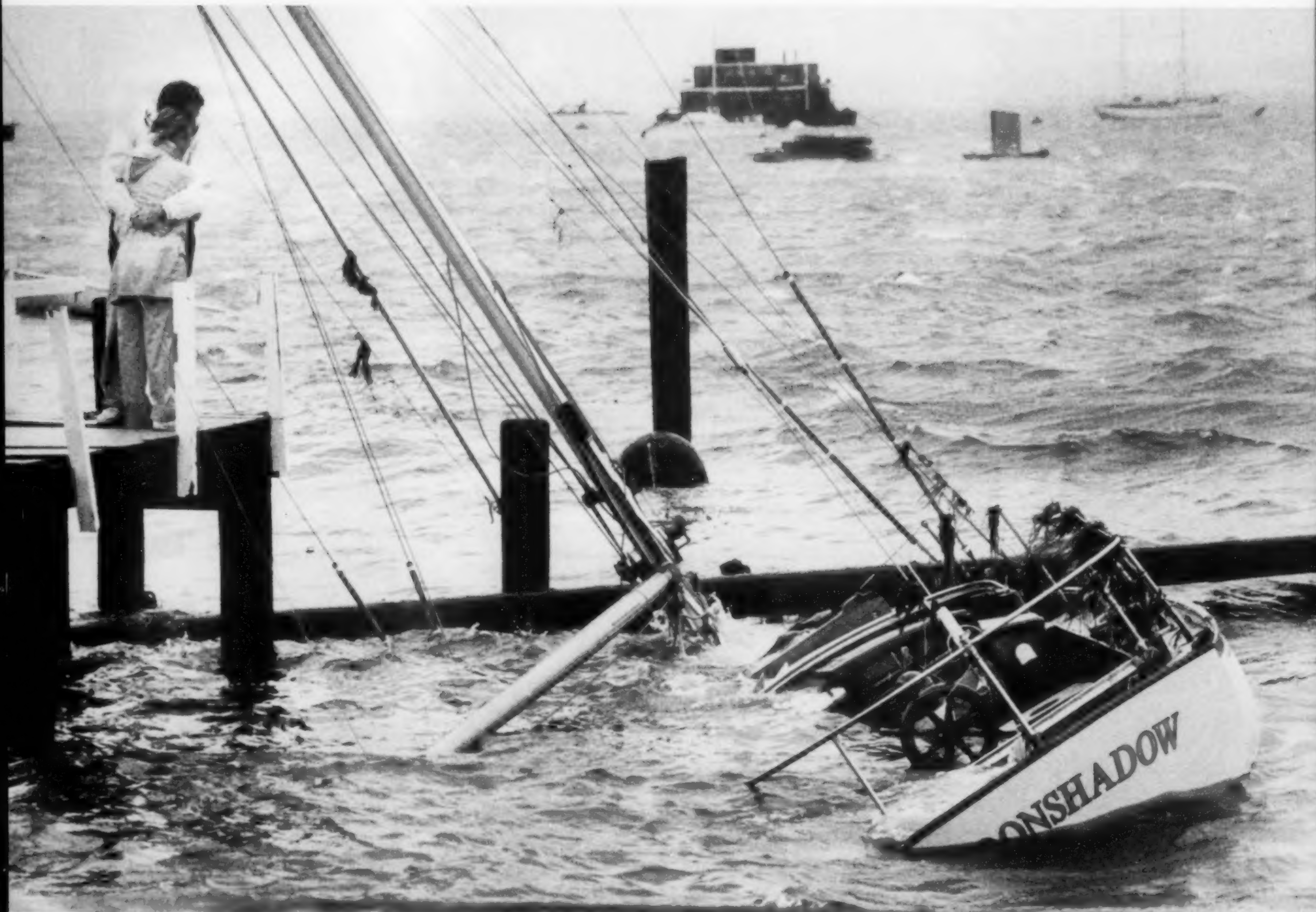
None of these priceless data, which provide a look at the climate over the past 150 years, would be available today without the dedication and devotion to duty of the marine weather observer. It is an outstanding legacy and one that continues today by equally talented and devoted mariners. For this we are grateful and look forward to a continuation of this valuable program into the next century.

North Atlantic Hurricanes—1991

Lixion A. Avila and Richard J. Pasch

The 1991 hurricane season was characterized by high-latitude tropical cyclone origins and tracks, only one U.S. landfall and no tropical storms or hurricanes in the Gulf of Mexico. This lack of Gulf of Mexico tropical storms and hurricanes is a rare event that has occurred only two other times this century (1927 and 1962).

There were eight tropical storms, four of which became hurricanes. The long-term average is ten and six respectively. Additional-



The Boston Globe/ Bill Greene

Hurricane Bob created some problems and heartbreak in Woods Hole, MA and other areas along the New England coast. A couple find comfort in each others' arms after finding their sailboat swamped at its mooring (page 14), while an unidentified woman struggles against the wind and rain (right).

The Boston Globe/ Bill Greene

ly, there were four tropical depressions which did not become named storms. The 1991 tropical cyclone activity was markedly decreased from the 1990 season's total of 14 tropical storms of which eight became hurricanes. The subtropical North Atlantic region, within several hundred nautical miles southwest through southeast of Bermuda, was a *hot spot* for development this year.

Since the majority of the tracks were over open waters, ship observations along with satellite coverage continued to be of vital importance in monitoring tropical systems. The strongest winds associated with a tropical system came from an unidentified ship during Hurricane Bob on August 19 at 1200 UTC. It is interesting to note that the most significant observations of winds and seas during the 1991 season came from vessels which encountered a late season, non-tropical storm, which ultimately evolved into an unnamed hurricane.

Note that tropical cyclone positions given in this report refer to the location of the center. Tropical cyclones generally cover thousands of square miles and affect areas far from the center.

Lixion Avila and Richard Pasch are Hurricane Specialists at NOAA's National Hurricane Center (NHC) in Miami, FL. Hal Gerrish, Miles Lawrence, Max Mayfield and Ed Rappaport from NHC also contributed to this report.

Tropical Storm Ana

Ana, the first tropical storm of the season, developed about 85 nautical miles south of Charleston, South Carolina, accelerated northeastward and became extratropical over open waters. The strongest ship-reported winds associated with Ana were 45 knots from a vessel about 20 nautical miles south of the center on the 4th of July. On the 5th, another vessel, the ***Loyalty***, encountered the storm and observed 35-knot winds.

Hurricane Bob

Bob was the only hurricane to make landfall in the United States this season, causing the deaths of 18 people and damage estimated at \$1.5 billion. This makes Bob the most recent in a series of hurricanes that have caused damage exceeding \$1 billion in the eastern United States.

Bob originated from a large area of disturbed weather associated with the remnants of a frontal trough near Bermuda. It became a tropical depression on the 16th of August, when centered 175 nautical miles east of Nassau in the Bahamas, and was upgraded to a tropical storm on that same day.

1991 North Atlantic Hurricanes and Tropical Storms

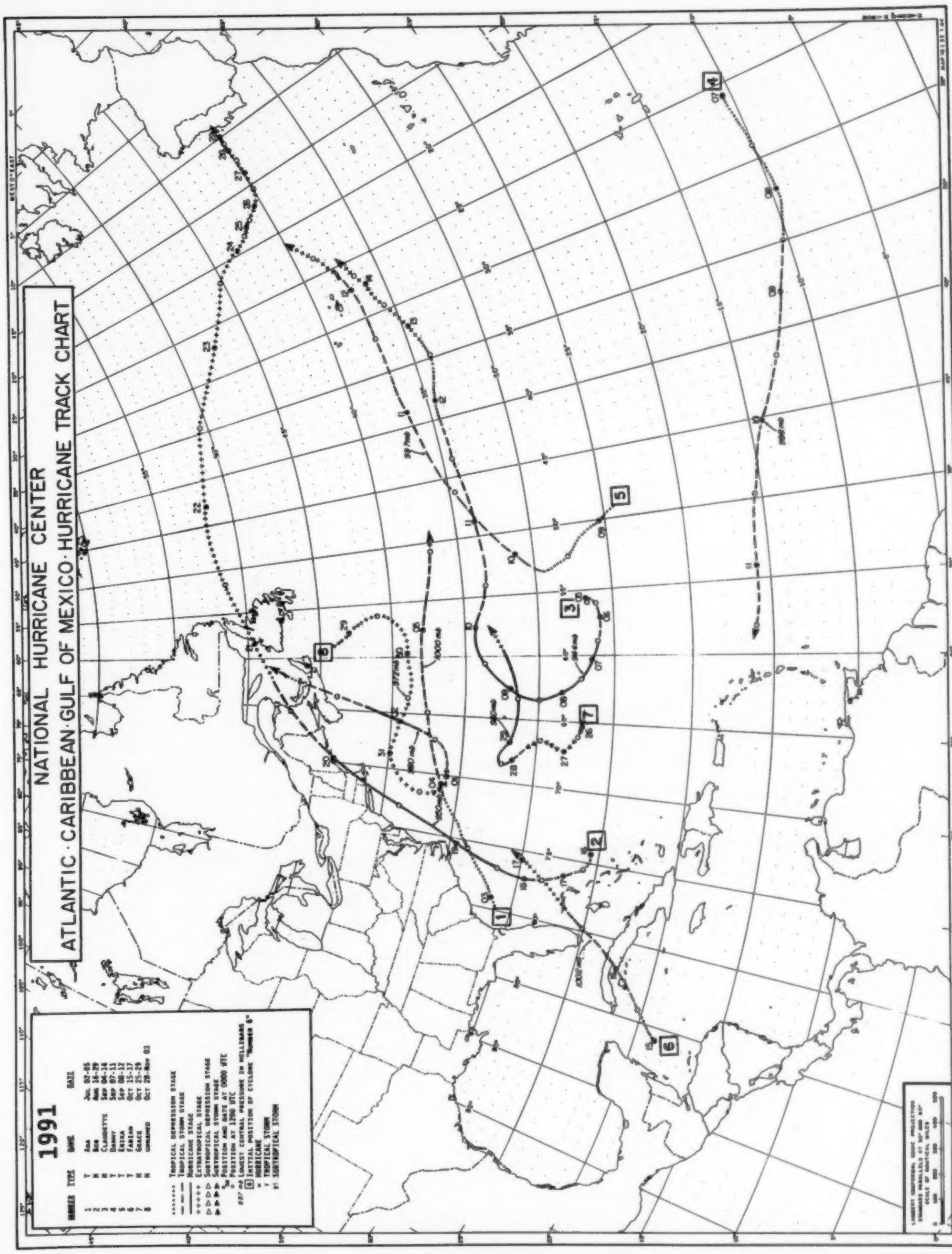
Name	Class[a]	Dates[b]	Maximum sustained wind (knots)[c]	Lowest pressure (mb)	U.S. damage ($billions)	Deaths[d]
Ana	T	7/02-7/05	45	1000	–	–
Bob	H	8/16-8/29	100	950	1.5	18
Claudette	H	9/04-9/14	115	944	–	–
Danny	T	9/07-9/11	45	998	–	–
Erika	T	9/08-9/12	50	997	–	–
Fabian	T	10/15-10/17	40	1002	–	–
Grace	H	10/25-10/29	90	980	–	–
Unnamed	H	10/28-11/02	65	980	–	–

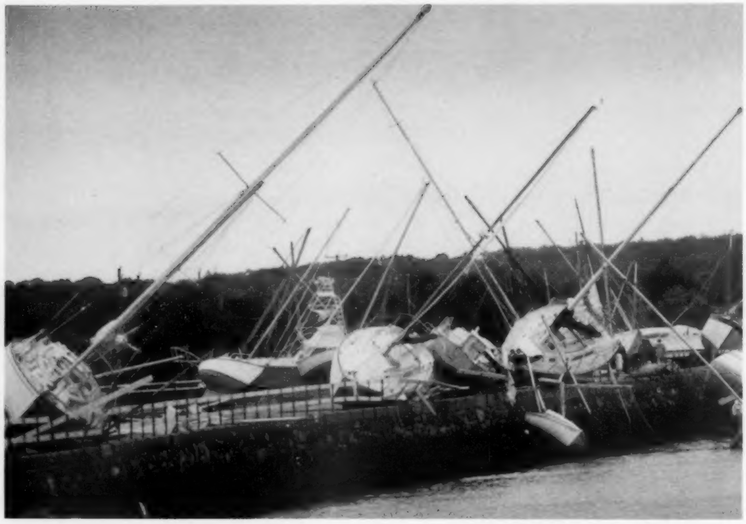
[a]T:tropical storm, wind speed 34-63 knots. H:hurricane, wind speed 64 knots or higher.
[b]Dates begin at 0000 Universal Time and include tropical depression stage.
[c]Wind speed over a one-minute span.
[d]Includes deaths outside the United States.

Tropical Cyclone Winds
(Ship encounters of 34 Knots or higher)

Tropical Cyclone	Ship Name	Date Mo/Da	Time UTC	Position LatN	Position LonW	Wind(kn) Dir/Speed	Pressure (mb)
Ana	unknown	7/4	0900	37.0	66.5	240/45	1003.0
	Loyalty	7/5	0000	37.0	57.4	220/35	1003.1
Bob	Sanko Pioneer	8/16	1800	26.0	72.9	170/44	1016.0
	Mangal Desai	8/18	1800	30.1	77.8	260/35	1011.5
	Chablis	8/18	1800	32.1	78.9	330/35	1008.1
	unknown	8/18	1800	33.0	74.4	190/44	1008.0
	unknown	8/19	1200	38.0	74.5	330/60	1002.2
Claudette	Mar Transporter II	9/9	1800	32.5	58.0	240/34	1014.0
	Beursgracht	9/10	0900	32.2	56.6	290/40	1014.8
	unknown	9/10	0900	33.4	55.1	260/45	1002.0
	Allegro	9/11	1200	34.9	44.6	360/37	1013.2
Grace	Holstencarrier	9/26	1800	29.4	67.5	020/40	1003.5
	Walter Jacob *	9/27	0300	27.7	68.2	290/35	1000.0
	Dekabrist	9/27	0600	30.3	68.2	060/43	1000.5
	Walter Jacob *	9/27	0900	27.4	69.8	330/35	1003.0
	Pato Bolo	9/27	1000	29.4	71.8	060/45	—
	Holstencarrier	9/27	1200	31.9	70.8	020/40	1010.0
	Oleander	9/27	1800	33.7	65.9	090/35	1007.0
	Golden Endeavour	9/27	1800	28.0	58.5	130/35	1014.7
	Cape Hudson	9/27	2100	29.3	64.5	170/40	1003.5
	Cape Hudson	9/28	0000	29.1	65.2	190/40	1004.0
	Cape Hudson	9/28	0300	29.1	66.4	220/45	1003.5
	Oleander	9/28	0600	32.1	64.7	080/48	1003.5
	Durian Queen	9/28	0900	36.2	72.9	360/35	1008.5
	X7	9/28	1200	31.2	70.9	310/35	1002.5
	Durian Queen	9/28	1800	29.3	71.6	320/35	1006.5
	XC6F	9/28	1800	32.7	71.3	340/40	1004.5
	9110	9/28	1800	33.3	73.1	350/35	—
	Overseas Valdez	9/28	2100	30.7	72.9	310/40	—
	Humbergrcht	9/29	1200	31.5	57.5	190/45	1004.7
Unnamed	YFA7	10/31	1200	38.5	72.3	010/41	1000.5
	Sea Commerce	11/1	0000	33.9	70.1	270/40	1004.5
	CFL Atlas	11/2	0600	40.9	66.7	020/45	1006.5

* tentative identification


NATIONAL HURRICANE CENTER
ATLANTIC · CARIBBEAN · GULF OF MEXICO · HURRICANE TRACK CHART
1991



The Boston Globe/ David L. Ryan

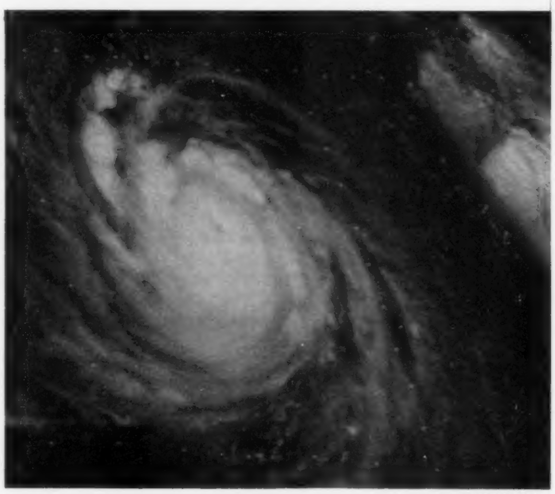
The storm reached hurricane status on the 17th about 200 nautical miles east of Daytona Beach, Florida, while heading toward the north. It then veered north-northeastward at an increasing forward speed. The hurricane reached its maximum intensity of 100 knots, with a minimum central pressure of 950 millibars, on the 19th, when it was located about 90 nautical miles east-southeast of Norfolk, Virginia. Bob was a Category 3 hurricane on the Saffir/Simpson Hurricane Scale at that time, but it weakened while accelerating toward the north-northeast over cooler waters off the mid-Atlantic coast. It made landfall as a category 2 hurricane near Newport, Rhode Island on that day.

Bob then moved over Massachusetts Bay, continued to weaken and began losing tropical characteristics as it passed just off the southern coast of Maine. It made final landfall as a tropical storm near Rockland, Maine by 0130 UTC August 20th, and turned northeastward crossing Maine and New Brunswick. Bob became extratropical over the Gulf of St. Lawrence later on the 20th. Finally, it crossed northern Newfoundland, and the central North Atlantic along 50° to 55°N, before moving southeastward and dissipating near the coast of Portugal on August 29.

Ships near the Atlantic seaboard did not escape from Bob's fury. The strongest reported winds were 60 knots from the northwest by a vessel located in the vicinity of 38.0°N 74.5°W on the 19th. When Bob was in its developing phase, the ***Sanko Pioneer***, located near the Bahamas, reported 44-knot winds. Three people in a 38-foot sailboat were trapped in Bob's circulation off Cape Hatteras and managed to survive after struggling for 10 days on a life raft. They were finally rescued by the Coast Guard and Navy off the New Jersey coast.

Hurricane Claudette

Claudette spent its life over open water and had the distinction of being the strongest hurricane of the season. It was spawned from a disturbance of non-tropical origin in the area southeast of Bermuda. After the system became a tropical depression on the 4th of September, it rapidly reached hurricane strength. Claudette further intensified to estimated maximum winds and minimum pressure of 115 knots and 944 millibars, respectively, on September 7. Claudette threatened Bermuda for awhile but it turned eastward away from the island. No ship had the misfortune to encounter the eye of this small but violent hurricane. Later, on the 9th, a ship passed south and very close to the system reporting westerly winds of 45 knots and a minimum pressure of 1002 millibars. Claudette was by then in its weakening stage. The system eventually dissipated in the vicinity



NOAA/NHC

Winds from Hurricane Bob carried sailboats from their moorings onto Bridge St. in Dartmouth (above). Dartmouth is in southeastern Massachussetts, about 6 miles southwest of New Bedford. It was formerly a shipbuilding and fishing center. Claudette (left) is located by satellite at about 1800 UTC on the 7th, near peak intensity.

of the Azores on September 14th.

Tropical Storms Danny, Erika and Fabian

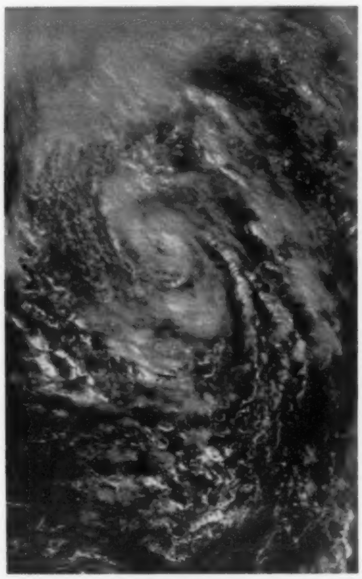
Tropical Storms Danny and Erika developed from tropical waves in the eastern and central Atlantic, respectively, during the peak of the season in September. Environmental conditions were quite hostile for development in the tropics and both systems failed to become hurricanes. Danny dissipated before it reached the Lesser Antilles and Erika turned toward the north and northeast over the Azores, where it became extratropical. Fabian developed in the western Caribbean in mid-October and rapidly moved northeastward over Cuba and the Straits of Florida. It became extratropical in the western Bahamas. Fabian produced abundant rains over central Cuba. There were no ship reports of tropical storm force winds associated with those storms.

Hurricane Grace

Since Hurricane Grace was initially subtropical in character, with its circulation encompassing a large area, numerous ships encountered it. These ship reports were vital in assessing the initial development and structure of Grace, and greatly assisted the forecast procedure. A series of observations from a ship tentatively identified as the ***Walter Jacob*** proved to be particularly useful in describing the early stage of Grace as a subtropical cyclone. The subtropical depression originated from an upper level disturbance located between Bermuda and the Bahamas. The system evolved into Tropical Storm Grace on the 27th of September, as convection and strong winds became concentrated near the center of circulation. Hurricane status was reached on the following day. Shortly after acquiring its peak intensity, 90-knot maximum winds and 982-millibar minimum pressure, Grace's circulation was abruptly destroyed by a cold front. Due to its large circulation, Grace generated large swells, of about 15 feet from off North Carolina, to about 10 feet near the Florida coast. Later, a large extratropical cyclone which developed off the coast of Nova Scotia, rather than Grace, caused treacherous seas over a large portion of the northwestern Atlantic shoreline. The strongest sustained wind reported by a ship was from the east at 48 knots, observed by the ***Oleander*** on the 28th. However, the ***Pato Bolo*** recorded the highest wind gust, 67 knots on the 27th.

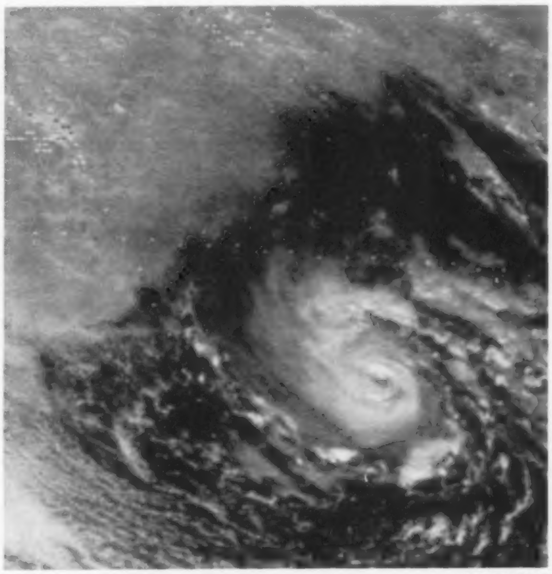
Unnamed Hurricane

The last system of the season was a rather unusual but not unprecedented event, which consisted of the formation of a tropical cyclone of hurricane strength within the aforementioned extratropical cyclone. After reaching its peak intensity as a damaging storm, the weakened extratropical low moved over a portion of the Gulf Stream south of New England. With the low moving over warm waters, convection increased near the circulation center to a point where a tropical cyclone could be identified within the central area of the low. On the 1st of November, satellite images showed an eye forming, indicating that the inner system was near hurricane strength. Indeed, an Air Force Reserve Unit aircraft confirmed that the system was already of hurricane intensity



NOAA/NHC

Amazing Grace (left), at about 1900 on the 28th, and the unnamed hurricane (right) were participants in the story of the Halloween Storm, which wreaked havoc along the U.S. East coast during the last part of October. Notice the telltale eye in the unnamed hurricane in this shot that was made at about 1700 UTC on the 1st of November.



NOAA/NHC

when the plane encountered flight level winds of 86 knots and a 981-millibar minimum pressure near 0000 UTC on November 2nd. The tropical cyclone made landfall near Halifax, Nova Scotia at 1400 UTC November 2d as a weakening tropical storm.

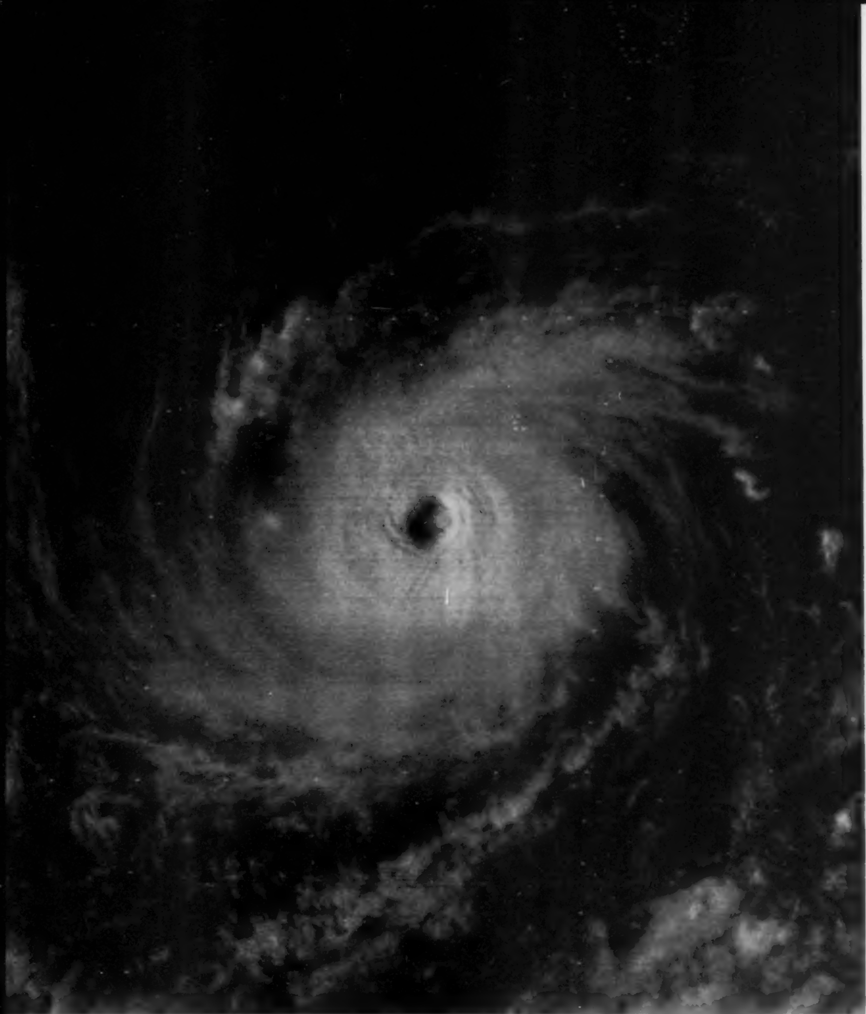
Several vessels passed close to the extratropical storm center on October 30 and reported winds of 50 to 60 knots. A buoy measured a peak wave height of 101 feet and a ship reported 80-feet seas and 80-knot winds on October 30, while several hundred miles northwest of the storm center. It is important to note that these strong wind speeds and high wave heights were associated with the extratropical stage of the system, and not with the hurricane, which formed later. The table includes only the observations taken during the system's tropical and subtropical stages.

On the 2d of November, a Bahamian ship, the *CFL Atlas*, located about 110 miles southwest of the center of the tropical system, reported winds from 020° at 45 knots and pressure of 1006.5 millibars. The minimum pressure observed by a ship came from the YFA7 which reported 1000.5 millibars.

This hurricane was largely a separate phenomenon from the strong extratropical storm, which caused major coastal damage along the east coast from Florida through Canada, and even over portions of Atlantic shorelines of the Greater Antilles. The extratropical system was on the wane, with conditions improving on the coasts, when the tropical cyclone formed. It was believed that naming the system (which met all of the meteorological criteria to be designated as a hurricane) at that time would cause confusion among the media and the public. Since the hurricane was expected to be short-lived and primarily a problem to marine interests, it was decided to handle all associated warnings in enhanced High Seas and Offshore and Coastal Waters Forecasts. Based upon reports to date, this process provided all necessary warnings.

Tropical Cyclone Names for the Northern Hemisphere–1992 Season

North Atlantic	Eastern N. Pacific	Western N. Pacific	Central N. Pacific
Andrew	Agatha	Axel	Alika
Bonnie	Blas	Bobbie	Ele
Charley	Celia	Chuck	Huko
Danielle	Darby	Deanna	Ioke
Earl	Estelle	Eli	Kika
Frances	Frank	Faye	Lana
Georges	Georgette	Gary	Maka
Hermine	Howard	Helen	Neki
Ivan	Isis	Irving	Oleka
Jeanne	Javier	Janis	Peni
Karl	Kay	Kent	Ulia
Lisa	Lester	Lois	Walaka
Mitch	Madeline	Mark	
Nicole	Newton	Nina	
Otto	Orlene	Omar	
Paula	Paine	Polly	
Richard	Roslyn	Ryan	
Shary	Seymour	Sibyl	
Tomas	Tina	Ted	
Virginie	Virgil	Val	
Walter	Winifred	Ward	
		Yvette	
		Zack	
		Angela	
		Brian	
		Colleen	
		Dan	



Eastern North Pacific Hurricane Season—1991

Edward N. Rappaport and Max Mayfield

The year 1991 marked just the third time in the last 35 years that an eastern Pacific tropical storm or hurricane did not make landfall (the other years were 1980 and 1988). However, a tropical depression (5E) did come ashore near Salina Cruz, Mexico early on the 30th of June. It resulted in the year's lone fatality, as well as 500 injuries and significant damage to 118 homes. In addition, two people were reported missing. There were 40 people reported injured with the passage of Tropical Storm Ignacio just offshore of Lazaro Cardenas, Mexico during mid September.

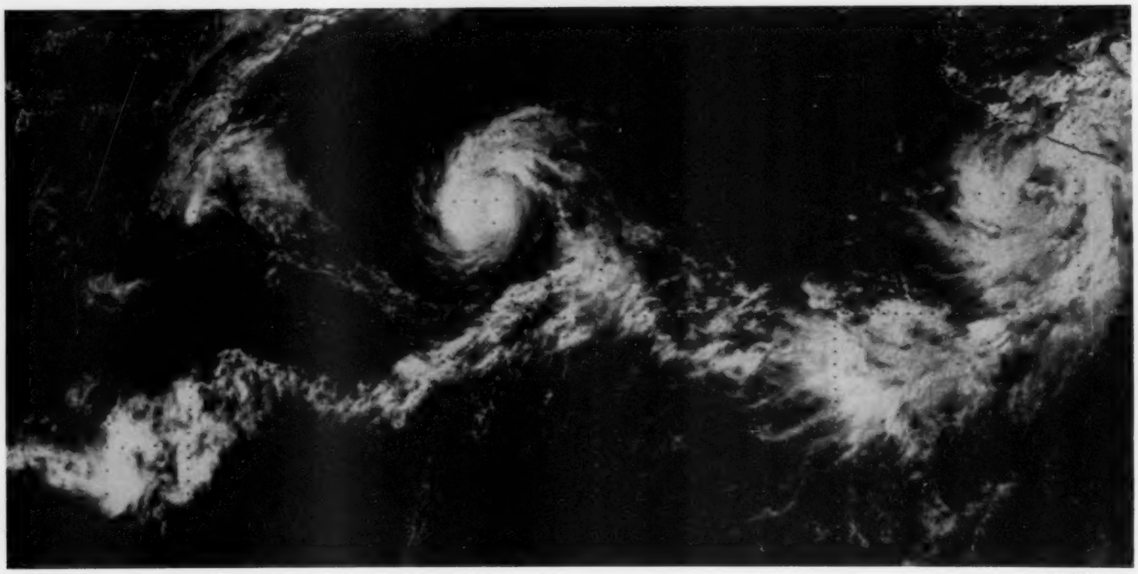
Without land to impede strengthening, some long-lasting intense hurricanes developed offshore. Several of them posed challenges for mariners. In fact, ships encountered 34 knot or higher wind speeds in five of this year's sixteen tropical cyclones.

Of the 16 tropical cyclones, 14 became tropical storms and 10 of those reached hurricane intensity. These numbers are fairly close to the long-term averages.

In addition to the ship reports, surface and upper-air sounding data from land sites, and observations from weather satellites were used in operational analyses and forecasts prepared by the National Hurricane Center (NHC). Also, for the first time in 5 years, data from instrumented aircraft in the eastern Pacific were available to the NHC. The aircraft, from NOAA and the National Center for Atmospheric Research, were participating in the Tropical Experiment in Mexico (TEXMEX), a research program on tropical cyclone formation. Data from these sources indicated that tropical waves contributed to the formation of most, if not all, of the tropical cyclones this year.

The 1991 season had one of the earliest starts on record, beginning on the 16th of May with the formation of Tropical Storm Andres. The season also ended rather late, with Nora becoming the first eastern Pacific hurricane

Edward N. Rappaport and Max Mayfield are Hurricane Specialists at NOAA's National Hurricane Center. Also contributing to this report were Lixion Avila, Hal Gerrish, Miles Lawrence and Richard Pasch, who are also Hurricane Specialists at NHC.



NOAA/NHC

A faint eye is seen in Hurricane Carlos in the satellite photograph (above) taken at about 2200 UTC on the 23d of June, when the hurricane, generating 100-knot winds, was centered about 1000 nautical miles southwest of the southern tip of Baja California. *The remnants of Tropical Storm Blanca can be seen about 900 nautical miles to the west of Carlos, while the tropical depression visible near the coast of Mexico is the system that developed into Hurricane Delores.*

during the last quarter century to form in November. Between Andres and Nora, the eastern Pacific had several periods with multiple tropical cyclones. Conversely, the month of July was unusually quiet. Only two systems formed all month–the fewest for a July since before 1973. Normally six tropical cyclones form during that month.

All of this year's ship reports of tropical storm conditions came from vessels located just off the southwest coast of Mexico, generally between Manzanillo and Acapulco (east of 106°W and between 13° and 21°N). The first of these encounters came late on the 24th of June during (then Tropical Storm) Delores, when a 35-knot wind was observed aboard the ***Ficus*** and the ship with call sign 8EG7 reported 39 knots. The ***Sidney Express*** also observed 35 knots in Delores about 24 hours later, by which time the system had become a hurricane.

The ***Toluca*** passed close to Tropical Depression Five-E. The ship reported 1004.0 mb and 38-knot winds, but was situated in an area where topographic effects may have locally amplified the wind speeds. Nevertheless, these ship data suggest that the depression was on the verge of becoming a tropical storm when the system moved inland.

The next ship report of tropical-storm force winds came during mid September when Tropical Storm Ignacio made a clockwise loop just offshore. The ***OMI Willamette*** and the ***Texaco Georgia*** reported 40 and 34 knot winds, respectively.

The ***Texaco Georgia*** is also recognized for making the highest wind observation that the NHC received from a ship in the eastern Pacific during 1991. On the evening of the 9th of October, just south of the center of Hurricane Marty (then a tropical storm), the ***Texaco Georgia*** observed a west-southwest wind of 50 knots. Several other ships near Marty reported winds of at least 34 knots.

In addition to these systems, the eastern Pacific also produced five major hurricanes (wind speeds > 95 knots). One of them, Hurricane Kevin, was the remaining tropical cyclone that ships reportedly encountered this year.

Major Hurricanes

Hurricane Carlos

Carlos formed from a tropical wave, which crossed Central America to the eastern Pacific on the 14th of June. The wave and its shower activity soon became better organized, and by the 16th of June had developed into a tropical depression. Rather rapid intensification followed, and in less than 48 hours the depression strengthened to become Hurricane Carlos.

After weakening briefly, Carlos' strengthening resumed and the hurricane reached its peak intensity of 105 knots on the 24th. During this period, a strong high devel-

oped to the north of Carlos and the steering flow around the high temporarily forced the tropical cyclone to the west-southwest.

After the 24th, Carlos experienced strong upper-level shear and moved over cooler waters. These conditions led to its dissipation by late on the 27th.

Hurricane Fefa

Fefa formed from a tropical wave that entered the eastern Pacific hurricane basin on the 25th of July. Cloudiness near the wave became better organized by the 28th. Data from a TEXMEX aircraft indicated that a 700–millibar cyclonic circulation center had formed within the wave by early the next day, but evidence of a low-level center was lacking at that time. Nevertheless, the system became a tropical depression late on the 29th. It probably formed in association with the 700 millibar center previously identified.

The depression intensified quickly to become Tropical Storm Fefa. Flight-level data on the 29th and 30th of June showed a broad area of 35 to 50 knot winds at low levels. Interestingly, the 950–millibar center was displaced about 30 nautical miles to the northwest of the center of a 700–millibar vortex detected at about the same time.

Fefa reached hurricane strength on the 31st of July. Satellite imagery showed strong upper-level outflow and an eye on the 1st of August. The hurricane reached its maximum intensity of 105 knots early on the 2d of August.

Throughout its lifetime Fefa moved toward the west or west-northwest. When the hurricane crossed 140°W on the 5th of August, operational responsibility for the system was passed to the Central Pacific Hurricane Center (CPHC) in Hawaii. Their analyses indicated that Fefa produced local squalls and high surf on the island of Hawaii. Fefa weakened and then dissipated on the 8th of August, in a strongly sheared environment near the Hawaiian Islands.

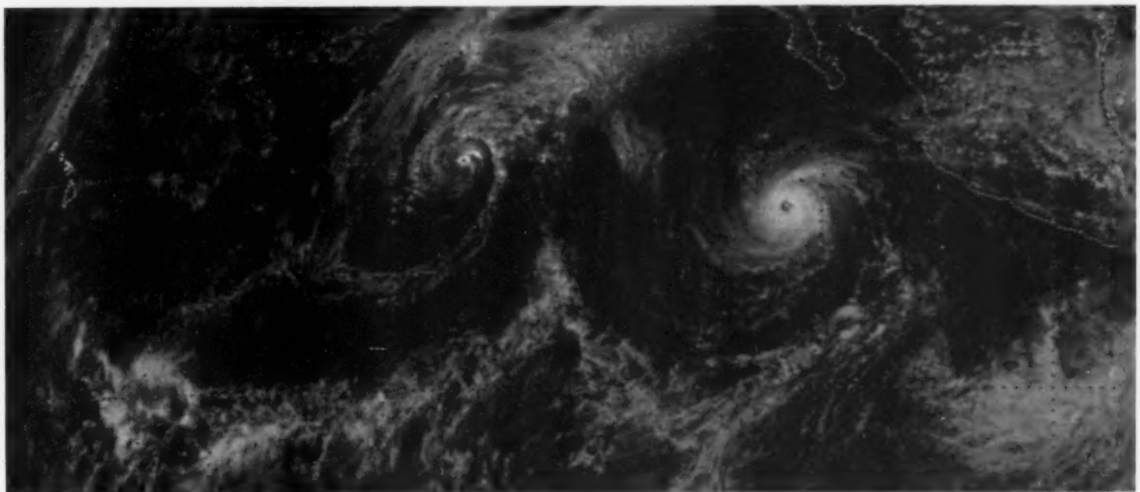
Hurricane Jimena

The tropical wave from which Jimena likely originated left the coast of Africa on the 5th of September. While over the eastern Atlantic, the wave formed Tropical Storm Danny.

The southern part of the wave continued westward and crossed Central America on the 14th and 15th of the month. The system developed into a tropical depression on the 20th and then into tropical storm Jimena a day later. Jimena moved toward the northwest, then the west and strengthened rapidly. It became a hurricane on the 22d. Upper-level outflow became distinct and a banding-type eye developed.

Satellite and aircraft data suggest that Jimena reached, and then generally maintained, its maximum intensity of 115 knots and minimum pressure of 945 millibars during the 23d and 24th. This made Jimena the first of two Saffir-Simpson Category 4 hurricanes in the eastern Pacific this year. Only slow weakening followed. Jimena still had a well-defined eye and winds of about 90 knots on the 28th.

It turned toward the northwest on the 29th, and that motion brought the hurricane into an area of lower sea-surface temperatures and relatively strong southwesterly



NOAA/NHC

Taken near 2100 UTC on the 30th of September, this satellite shot shows Tropical Storm Jimena centered midway between the Hawaiian Islands and Mexico, while Hurricane Kevin is near maximum intensity a few hundred nautical miles south of the Baja. On the right edge of the picture is a tropical disturbance south of Mexico, which developed into Hurricane Linda.

1991 Eastern North Pacific Hurricanes and Tropical Storms

No.	Name	Class[a]	Dates[b]	Max. sustained wind (kn)[c]	Lowest pressure (mb)	No.	Name	Class[a]	Dates[b]	Max. sustained wind (kn)[c]	Lowest pressure (mb)
1.	Andres	T	5/16-5/20	55	994	8.	Hilda	T	8/8-8/14	55	992
2.	Blanca	T	6/14-6/22	55	994	9.	Ignacio	T	9/16-9/19	55	994
3.	Carlos	H	6/16-6/27	105	955	10.	Jimena	H	9/20-10/2	115	945
4.	Delores	H	6/22-6/28	75	979	11.	Kevin	H	9/25-10/12	125	935
5.	Enrique	H	7/15-7/21	65	987	12.	Linda	H	10/3-10/13	105	957
6.	Fefa	H	7/29-8/8	105	959	13.	Marty	H	10/7-10/18	70	979
7.	Guillermo	H	8/4-8/10	70	983	14.	Nora	H	11/7-11/12	90	970

Table and Track Chart Legend

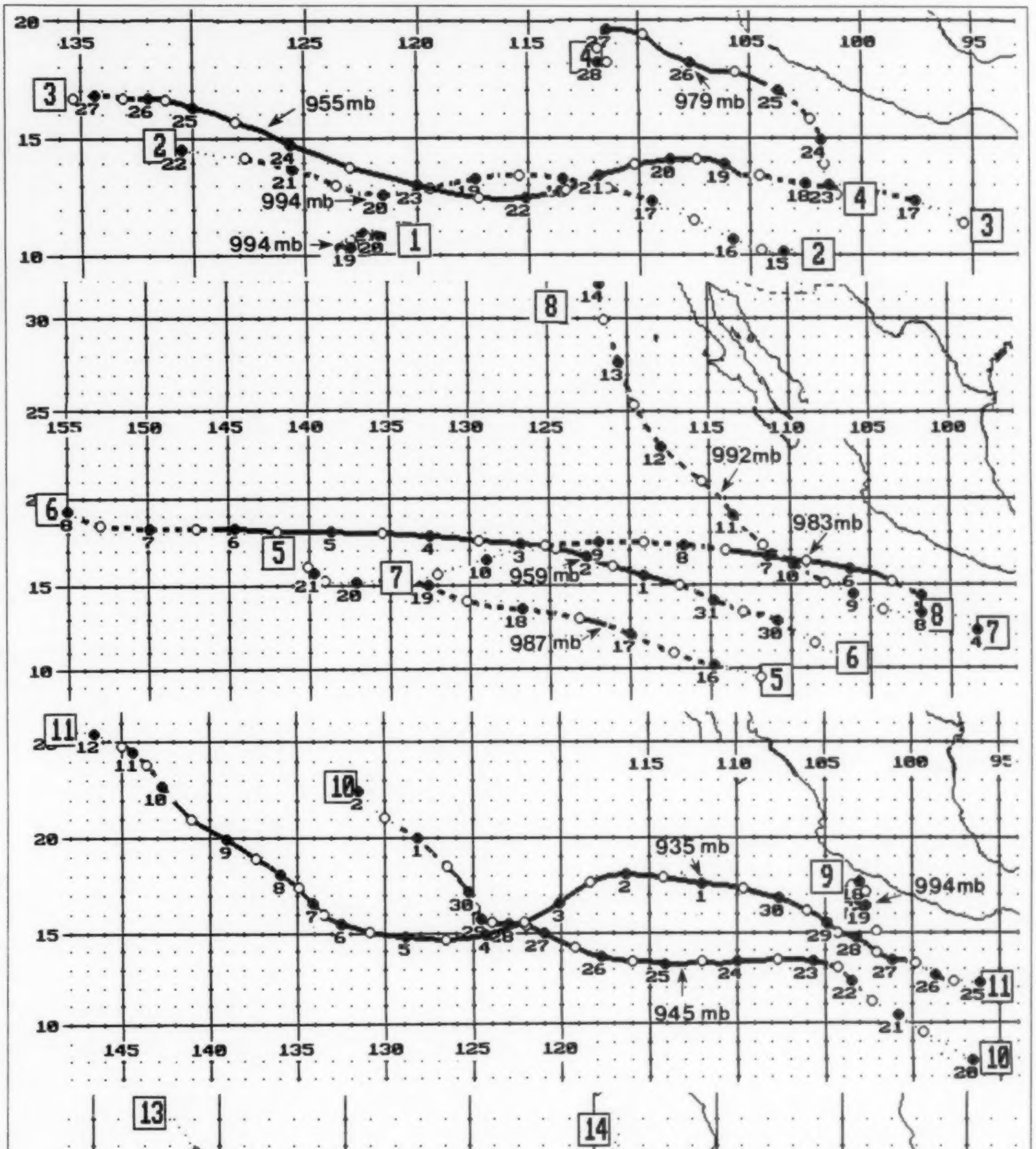
[a]T:tropical storm, wind speed 34-63 knots.
H:hurricane, wind speed 64 knots or higher.
[b]Dates begin at 0000 UTC (includes tropical depression stage).
[c]Wind speed over a 1-minute span.

●●●●●●	Tropical depression stage
– – – –	Tropical storm stage
———	Hurricane stage
+ + + +	Extratropical stage
⊳ ⊳ ⊳	Subtropical storm stage
▶ ▶ ▶	Subtropical storm stage
$\bigcirc_{07}$	Position and date at 0000UTC
●	Position at 1200 UTC
$\boxed{6}$	Cyclone Number 6
H	Hurricane
T	Tropical storm
ST	Subtropical storm

Tropical Cyclone Winds
(ship encounters of 34 knots or higher)

Tropical Cyclone	Ship Name	Date Mo/Da	Time UTC	Position LatN	Position LonW	Wind (kn) Dir/Speed	Pressure (mb)
Delores	**8EG7**	6/24	1800	17.7	102.3	080/39	1005.0
	Ficus	6/24	1800	15.5	103.7	240/35	1008.5
	Sidney Express	6/26	0000	20.4	106.7	140/35	1006.3
Five-E	**Toluca**	6/29	1800	16.1	95.2	340/38	1004.0
Ignacio	**Texaco Georgia**	9/16	1800	16.9	103.5	100/35	——
	OMI Willamette	9/17	0100	17.4	102.4	060/40	1005.0
Kevin	**Sedco-BP471**	9/26	0900	14.1	100.1	040/35	1003.9
	Sedco-BP471	9/26	1200	13.9	100.6	010/36	1003.0
	Marienvoy	9/26	1500	14.5	99.5	120/34	1009.0
	Sedco-BP471	9/26	1500	13.6	101.2	020/38	1002.9
	Marienvoy	9/26	1800	15.0	100.0	110/34	1009.6
	Sedco-BP471	9/26	1800	13.1	101.3	300/35	1001.9
	Marienvoy	9/27	0000	15.3	101.2	110/34	1007.0
	Brooks Range	9/27	1800	17.1	102.6	070/45	1010.0
	Star Livorno	9/30	0000	18.7	104.3	140/37	1009.5
Marty	**Sisala**	10/9	0000	16.4	99.6	090/40	1008.5
	Chesapeake Bay	10/9	0300	16.8	101.0	100/35	1008.5
	Chesapeake Bay	10/9	0600	16.6	100.5	080/40	1008.1
	Start Honkonk	10/9	0600	16.4	101.3	080/35	1007.5
	Chesapeake Bay	10/9	0900	16.5	100.3	090/40	1008.7
	Star Hong Kong	10/9	0900	16.3	101.0	080/36	1004.9
	Chesapeake Bay	10/9	1200	16.4	99.9	110/37	1010.0
	Star Hong Kong	10/9	1500	15.9	100.4	130/36	1011.8
	Texaco Georgia	10/10	0300	15.8	104.5	250/50	1005.0
	Nedlloyd Barcelona	10/11	0000	19.5	105.5	140/42	1008.8
	GYYP	10/13	0600	19.0	104.9	150/47	1013.0

1991 Eastern North Pacific Tropical Cyclones



winds aloft. Jimena weakened quickly in that environment and by late on the 30th the circulation center was devoid of deep convection. This left a low-level cloud swirl which gradually spun down. By the 2d of October the system had dissipated.

Hurricane Kevin

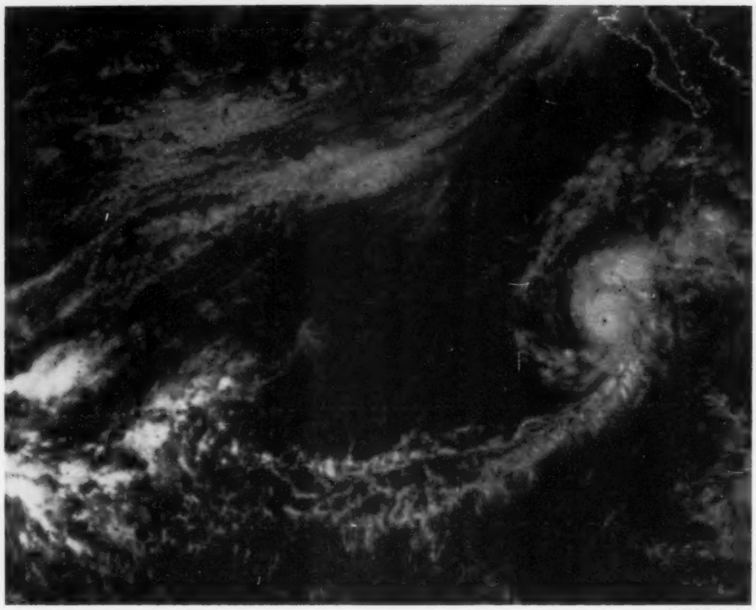
Kevin provided two highlights. Not only was it the season's strongest hurricane with Category 4 winds estimated at 125 knots, but by remaining a hurricane for 12 days to the east of 140°W, it also became the most enduring eastern Pacific hurricane on record.

Kevin formed from a tropical wave that moved into the eastern Pacific hurricane basin on the 21st of September. The convection became better organized on the 23d and 24th and the system progressed rapidly through the tropical depression stage to become Tropical Storm Kevin on the 25th. Convective banding and upper-level outflow grew more distinct on the 26th and Kevin became a hurricane that day.

Several ships reported tropical-storm force winds on the 26th and 27th. The ***Brooks Range*** had the highest surface wind reported for Kevin, 45 knots. Late on the 26th, the ***Sedco-BP471*** measured a pressure of 1001.9 millibars. This was the season's lowest pressure report received from a ship.

Between the 27th and 29th, Kevin strengthened. Satellite imagery showed the formation of a well-defined eye, which persisted for several days. Kevin reached its peak intensity on the 1st of October.

It began moving toward the west-southwest and this course was maintained for several days. During this period, Kevin's winds decreased to 75 knots. A more northerly track resumed by the 6th of October. The hurricane then



NOAA/NHC

This high resolution GOES image (page 21) was taken while Hurricane Kevin was centered about 300 nautical miles south southwest of the southern tip of Baja California near 2300 UTC on the 30th of September. Above, a GOES visible image taken on the 9th of November at about 2200 UTC, indicates a well-defined eye in Hurricane Nora. The hurricane was centered about 600 nautical miles south southwest of the southern tip of Baja California and was near its peak intensity of 90 knots.

reintensified, and by the 8th, Kevin had regained 100 knot winds.

The hurricane crossed 140°W on the 9th of October, into the CPHC area of responsibility. During the next few days, Kevin weakened and then lost its tropical characteristics over the cool waters that lie well to the northeast of Hawaii.

Hurricane Linda

Linda developed from a tropical wave that crossed Central America to the eastern Pacific on the 25th of September. Although convection flared up on the 30th, the system did not develop into a tropical depression until the 3d of October.

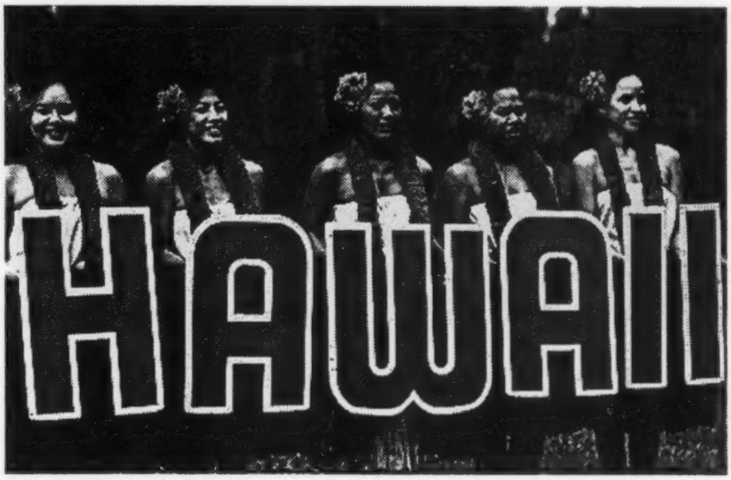
It initially moved toward the northwest until steering currents weakened. Linda then drifted, first toward the north, then the north northeast from the 3d through the 5th. Linda's intensification over this period was rapid. It reached hurricane strength early on the 5th and attained its estimated maximum winds of 105 knots late that day.

Linda turned west-northwestward by the 7th of October. The system weakened when it moved over a patch of water that had been cooled by upwelling associated with Hurricane Kevin's passage a few days earlier. Even so, the hurricane caused 70-knot sustained winds at Socorro Island. This was the strongest wind from a surface site in 1991.

Strong upper-level winds sheared the deep convection near Linda's center by late on the 9th. Only low clouds remained and Linda weakened to a depression a day later. Although deep convection periodically appeared over the next few days, the system dissipated on the 14th.

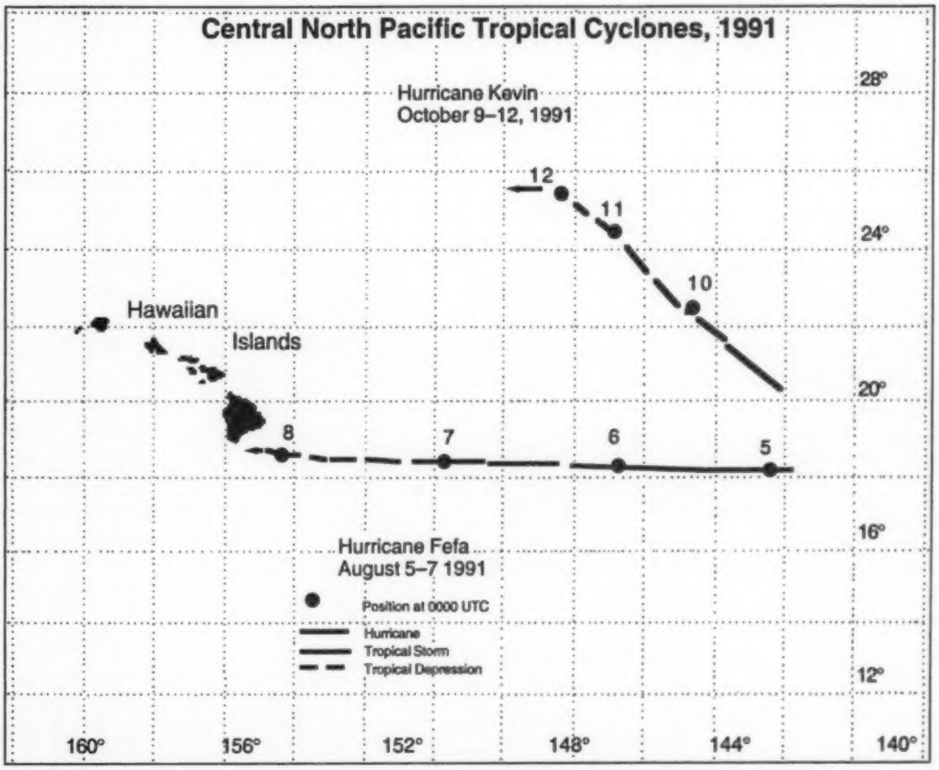
The Central North Pacific hurricane season ended with just three tropical cyclones in the area. All three systems had been hurricanes in the eastern North Pacific, with Enrique weakening to a tropical depression before entering the area.

Enrique entered the Central Pacific Hurricanes Center's (CPHC) forecast area as a weakening tropical depression at about 0000 UTC on the 21st of July with sustained winds estimated at 25 knots. The remnant circulation passed 140°W and moved northwestward, remaining well east and north of the Hawaiian Islands. On the 24th, the remains of the depression reached 24°N, 150°W, and by the 26th it was observed by polar orbiting satellites as a small but well-organized circulation near 32°N, 160°W. The Joint Typhoon Warning Center subsequently issued advisories on the cyclone



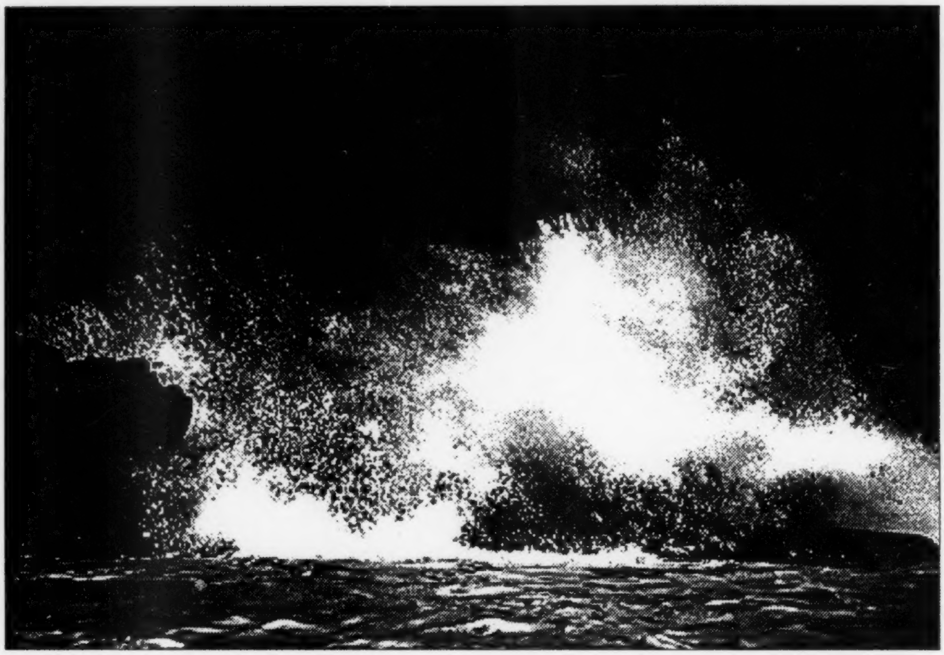
Central North Pacific Hurricanes—1991

Andrew K. T. Chun



Also contributing to this article which is an excerpt from NOAA Technicla Memorandum NWSTM PR–37, was Raymond T. Martin, Hans Rosendal and Glenn H. Trapp, all from the Central Pacific Hurricane Center.

Fefa's approach resulted in rough surf and gusty winds over the counties of Hawaii and Maui. Some very heavy downpours occurred, particularly on the Big Island of Hawaii, as thunderstorms developed in the northeast quadrant of the circulation. The thunderstorms formed offshore to the northeast of the Big Island and built rapidly southwestward over the slopes over Mauna Kea and the Kohala Mountains. Localized flash flooding was reported in the Kohala and Hamakua districts on the 7th.



Uniphoto

when it reintensified into a minimal tropical storm west of the International Dateline.

Hurricane Fefa was still an intense hurricane with winds estimated at 90 knots when it crossed 140°W into the CPHC's area of responsibility at 0600 UTC on the 5th of August. Fefa moved westward at 15 knots toward the Hawaiian Islands. The center of Fefa passed close to or over the Big Island at 0000 UTC on the 8th as the sea level pressure at Hilo dropped to 1005 mb, but it was only a tropical depression at that time. Fefa's remnants interacted with the island's terrain and a cold core upper trough, which had been present near the islands for several days. This trough was largely responsible for the quick demise of Fefa due to strong vertical wind shear over the area, with strong easterly winds near the surface and westerly winds aloft. Nevertheless, locally strong winds did occur on the north side of the remnant circulation. Wind gusts ranged between 40 and 50 knots at some localities, mainly over the counties of Hawaii and Maui. Some very heavy downpours occurred, particularly on the Big Island of Hawaii, as thunderstorms developed on the northeast quadrant of the circulation. Lightning was responsible for two injuries on the Big Island.

Kevin had been a moderately strong hurricane for well over a week, while moving slowly but steadily in a northwesterly direction toward the central Pacific. It was far north of Hawaii when crossing the 140th meridian and barely at hurricane strength. As is the case with most storms that are well offshore and parallel the islands, Kevin interrupted the trades, which resulted in sunny and fair weather over the Hawaiian Islands. Kevin was barely at hurricane intensity when it entered the central Pacific and was downgraded to a tropical storm on the 9th. By the 11th, it was a depression.

Central North Pacific Tropical Cyclone Summary, 1991

Name	Dates	Classification in CPHC area	Max Winds (kn)
Enrique	Jul. 20–21	Trop. dep.	25
Fefa	Aug. 5–8	Hurricane	90
Kevin	Oct. 9–12	Hurricane	65

Block Island Lights

Elinor DeWire
Mystic Seaport Planetarium

Midway between Newport, Rhode Island and Montauk, New York is an island that resembles a giant pork chop adrift on the sea. Block Island is its official name, but New Englanders affectionately call it the *Bermuda of the North,* since its beaches are tawny and inviting, and the weather is milder than anywhere else in the Northeast. Winters here are chipper, with a continual nipping wind, but rarely does snow lay or the island's many ponds freeze over. In other seasons, Block Island lives up to its nickname. Kissed by cool, fresh breezes and plentiful sunshine, and blessed with an *old-fashioned ambience,* it has become a major vacation destination.

In the age of sail, Block Island was a popular stopover for ships running between Boston, New York, and Philadelphia, in spite of the many navigational hazards surrounding it. Benjamin Franklin was among the dignitaries who regularly visited the island, but there were no lights in his time to guide vessels into Block Island's two main ports. Ships relied on bonfires that burned at both the northern and southern points, as well as on Beacon Hill, 211 feet above sea level at the center of 7-mile long Block Island.

Shipping losses in the vicinity of Block Island were costly in the years immediately following settlement.

Local Indians called the island Manisses–Isle of the Little God–but in 1614 Dutch navigator Arian Block chanced upon the spot and gave it his own name. Almost 50 years later the first settlers arrived to farm and fish. They would later discover the island's lure as a vacation destination and turn to tourism for their livelihood. Even so, only a few hundred people currently live on the island year-round.

Shipping losses in the vicinity of Block Island were costly in the years immediately following settlement. Some estimates put the

BLOCK ISLAND SOUTHEAST PAUL BRADLEY JR.

The Beebe Family at Southeast Lighthouse in 1944. Barbara Beebe Gaspar is third from the right. At this time her father was keeper of the light. Photograph courtesy of Barbara Beebe Gaspar.

number of wrecks as high as 1000, with most occurring off the island's north point. Not until 1829, however, was any effort made to mark the treacherous spit of sand and shoal believed to be the remnant of a land bridge that once connected Block Island with Rhode Island proper.

The Lighthouse overlooks the sea where the fabled Palatine lights are sometimes seen.

Two short towers, attached to either end of a 25-foot house were the first official lighthouses on the island. They served mariners for about a decade before erosion and complaints about their inefficiency forced the government to replace them. The second set of double towers fared no better and were abandoned in the 1850s in favor of a single tower. It lasted until the Civil War; then sand and water destroyed it.

The fourth and final lighthouse at Sandy Point was built in 1866, a sturdy granite house with a small tower rising from its roof. It was confidently dubbed *Old Granitesides* in hopes the erosion problem was halted, but the elements began a renewed assault and sand was soon stripped from its base. A solution came in 1873 when the immediate area around the lighthouse was paved with blocks to stabilize the lighthouse plot. Erosion continued, but at a snail's pace, and the old North Light still stands today.

Shortly after the lighthouse was established at Sandy Point, a second sentinel was built atop the Mohegan Bluffs on Block Island's southern shores. Southeast Light, perched 204 feet above sea level, is the highest lighthouse in New England. Its Gothic Revival architecture and the spectacular Mohegan Bluffs below it, make this sentinel one of the nation's most scenic.

The lighthouse overlooks the sea where the fabled Palatine Lights are sometimes seen. According to legend, the ship ***Palatine*** caught fire off Block Island. All aboard were rescued except for a frightened woman who had hidden below. As flames consumed the ship, her screams echoed across the water to the watchers on shore. Islanders say eerie, unexplained lights sometimes appear on the sea around Block Island, usually on calm, clear nights; and occasionally the lights are accompanied by the distant wail of a woman in distress. Many people believe these are the ghosts of the lost ship ***Palatine*** and her ill-fated passenger.

A number of Block Island lightkeepers and their children have shared memories of life on the island in the days before automation of the lighthouses. Barbara Beebe Gaspar has fond recollections of growing up at both of the Block Island lights where her father served some 20 years beginning in the 1920s. Barbara walked across the long spit at Sandy Point to catch the bus to Old Harbor School. Blowing sand stung her face, and during one windstorm her raincoat was shredded. In winter, the block pavement around the lighthouse iced over, and Barbara's father had to pull her up to the door on a rope, which she considered great fun.

Subsequent storms have brought the edge of the cliff to within 55 feet of the lighthouse.

Marie Carr, wife of lightkeeper Earl Carr, lived at Southeast Light during the 1938 hurricane. The storm threw stones up the cliff and hurled them through her living room window. Electricity failed in the afternoon, kicking on the emergency generator that powered the

The North Light (above, circa 1900) is 58 feet above the water at Sandy Point. Block Island itself consists of nerly 7,000 long and hilly acres, with elevations up to 200 feet. The shore of the island is fringed in most places by boulders and shoals abruptly. Photograph courtesy of Barbara Beebe Gaspar. Jessica DeWire (below) outshines the French Lens at the Southeast Light. Jessica, a talented musician and artist, designed several of our column logos and is the daughter of the author.

beacon, but the keepers still had to turn the lens by hand, since the rotating mechanism was not emergency powered. While the tower suffered little damage, 25 feet of the cliff behind the lighthouse washed into the sea.

"Nothing moves the imagination like a lighthouse."
—Samuel Drake

Subsequent storms have brought the edge of the cliff to within 55 feet of the lighthouse. Another storm like that of 1938 could undermine it completely. The Southeast Lighthouse Foundation has raised $1.8 million to relocate the historic tower 200 feet back from the cliff, but there's little time. Engineers say the structure cannot be moved once the distance separating it from the sea narrows to 40 feet. The relocation project is scheduled for the summer of 1992 and will be accomplished with hydraulic jacks that will lift the 60-foot tall lighthouse onto a railway and slowly roll it to its new location. Samuel Drake once said, "Nothing moves the imagination like a lighthouse." In this case, nothing moves a lighthouse like imagination!

"Nothing moves a lighthouse like imagination."
—Elinor DeWire

A museum already operates inside the Southeast Lighthouse, and the handsome French lens remains intact, though its function as a beacon has been taken over by a nearby skeleton tower that local residents refer to as the *Erector Set Light*. In its new location, the museum will re-open, offering tours of the historic sentinel and special events. The North Light has also been preserved by the North Light Commission. Exterior refurbishment is complete and funds are being raised to restore the interior and open the lighthouse as a museum with a resident caretaker. Thanks to the devoted preservation groups, two important relics in the history of Block Island are being saved.

Elinor DeWire

Legacies of the Deep

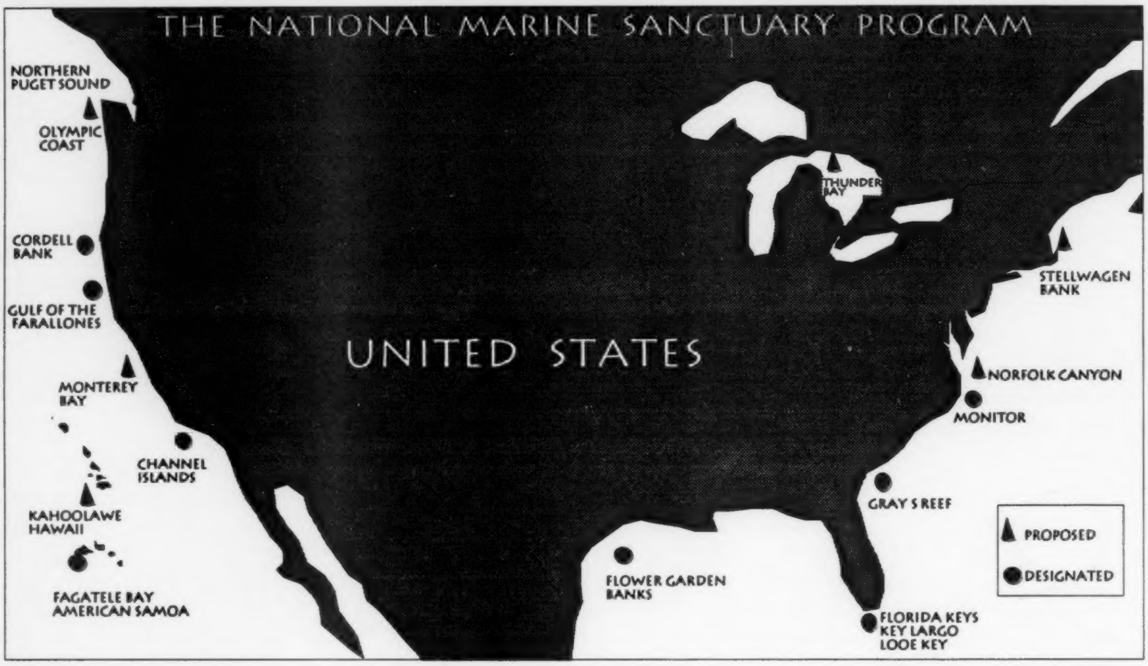
Bruce Terrell and Maureen Wilmot
National Ocean Service

Of all the ships that lie in the *Graveyard of the Atlantic* is there one more famous that the USS ***Monitor***? While surviving its Civil War battle with the ***Virginia*** (better known as the ***Merrimac***), this *cheesebox on a raft* could not weather the rough seas off Cape Hatteras, where it sank on December 30, 1862.

More than 100 years later the site of the ***Monitor*** became the first designated marine sanctuary. In addition to its cultural significance, this site supports integrated sponge, coral and fish populations, which makes it representative of the National Marine Sanctuary Program.

Today, with pollution and over-population attacking the three environmental spheres of earth, water and air, the National Oceanic and Atmospheric Administration has invested in a program to protect the most fragile and beautiful sphere of all–the ocean realm.

Under the Marine Protection, Research and Sanctuaries Act of 1972, NOAA has created a number of national marine sanctuaries to protect vulnerable resources and to encourage research that may offer help for environmental problems



on a planetary level.

This act was designed to protect specific coastal regions of the United States and its various territories and was passed in response to the growing awareness of threats to irreplaceable natural and cultural resources. Since implementation of the act, 10 national marine sanctuaries have been designated.

Like the ***Monitor***, all of the designated sanctuaries reflect a range of distinct marine environments. The Gulf of Farallones, Channel Islands and Cordell Bank sanctuaries, all off of the California coast, and the Gray's Reef (Georgia) and Monitor sanctuaries represent offshore marine environments in temperate zones. The Gulf of Farallones and Channel Islands also include islands and submerged nearshore environments. Cordell Bank is a submerged seamount. The Key Largo, Looe Key and Florida Keys sanctuaries, in Florida waters, and Fagatele Bay, in American Samoa, are tropical zone environments with coral reef and seagrass beds.

Educational programs are a vital component of the sanctuary program and are as varied as the resources they protect. Gray's Reef offers week-long, on-site classes to fifth grade students, while visitors to Channel Islands National Marine Sanctuary can "dive" into the kelp beds without getting their feet wet by using

remotely operated cameras Students can study the history of the ***Monitor*** at museum programs in Virginia or dive into an ecological study of coral reefs in the Coral Reef Classroom in the Florida Keys National Marine Sanctuary. The focus is to make people aware of these fragile resources and the need to protect them.

Sanctuaries may be designated in coastal and ocean waters and in the Great Lakes and their connecting waters. They may be located in both federal and state waters, with the help and approval of the affected states.

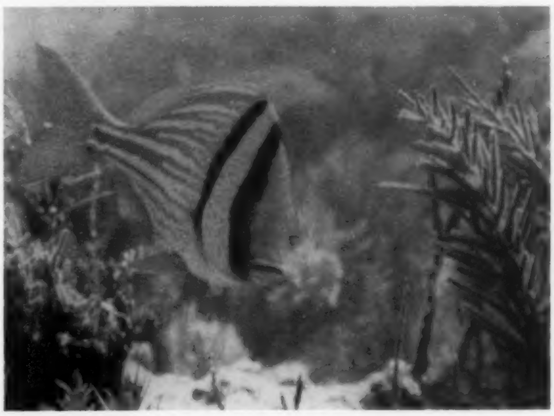
The public is included in the selection process. While the regions are protected with regard for their unique or threatened resources, the needs of the community are also considered. In addition to protection and research, recreation and commerce are provided for if they are in harmonious balance with the health and integrity of the resources.

The selection of sanctuaries is on-going. The Flower Garden Banks sanctuary in the Gulf of Mexico was designated this past January. In 1992, sanctuaries will be designated at both Monterey Bay off the California coast and at Stellwegen Banks off Cape Cod.

The Marine Protection, Research and Sanctuaries Act required that a Site Evaluation List be created that would identify nationally significant sites based on conservation, aesthetic, recreational, historical, research and educational values. Sites from the list will continue to be evaluated for sanctuary candidacy.

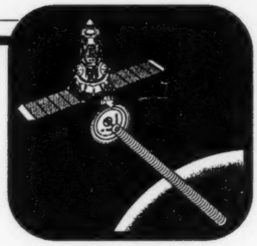
Administrative responsibility for the sanctuaries was placed with NOAA. While other federal state and agencies have managed underwater regions for individual resources, NOAA's Sanctuaries and Reserves Division has the unique opportunity to oversee the sanctuaries as complete ecosystems, including plant, animal and cultural resources.

The Monitor (left) was not good in rough seas and eventually succumbed to them. The rugged Channel Islands off California (above) and the beautiful underwater world of the Florida Keys (right) are both part of the National Marine Sanctuary Program.



Within the Sanctuary and Reserves Division is the Marine Archaeology and Maritime History Unit, which guides the management of the sites' cultural resources including historic shipwrecks and submerged prehistoric areas. For example, they are conducting research and surveys at the Channel Islands National Marine Sanctuary to identify areas where prehistoric peoples may have lived on the outer continental shelf during the late Pleistocene era. These now-submerged sites were formed when the sea level was approximately 300 to 400 feet lower than today. They have also surveyed the USS ***Monitor*** to determine extent of deterioration. of the site's remains. In addition, this unit reviews permit requests for historic resource site disturbance activities and inventories historic shipwrecks and archaeological sites which repose on the sanctuary bottomlands.

At a time when technology and development are threatening even the most pristine of environments, the National Marine Sanctuary Program offers a solution for research and protection of a significant portion of the environment, our marine coastal regions.

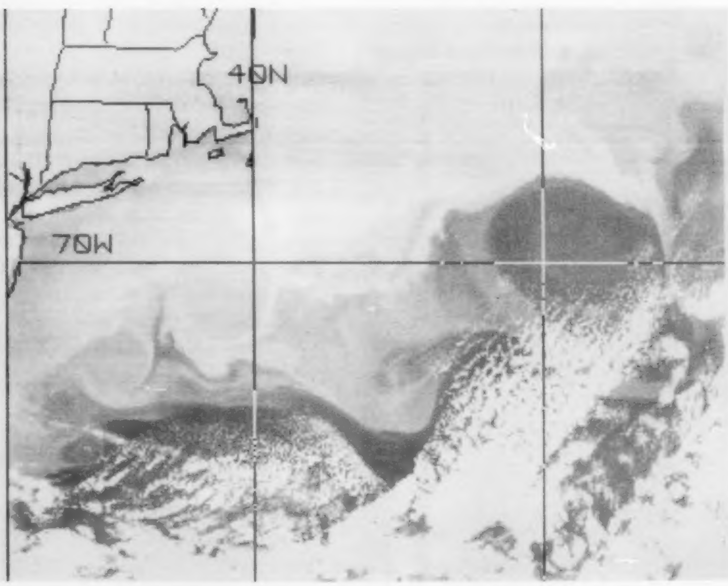


Ocean Features Analysis

Jenifer Clark
National Ocean Survey

Satellite data and ship observations go together like coffee and cream, with NOAA's Ocean Products Center (OPC) doing the stirring. Among their more useful satellite products for marine interests, are the Oceanographic Features Analysis (OFA) charts for the U.S. Atlantic coast. These charts are derived from polar orbiting, thermal infrared satellite images and data. They have proven valuable to marine transportation companies, universities, Coast Guard Search and Rescue units, ship routing firms, recreational boaters, fishermen and researchers.

Polar orbiting satellites orbit the Earth at an altitude of 833± 90 km. These satellites have high resolution infrared sensors that detect ocean surface temperature differences. Images from the polar-orbiters are automatically downloaded and are available on personal computers (PCs). NOAA oceanographers assimilate and analyze ocean features by satellite imagery interpretation. OFA features include the location of the Gulf Stream, Gulf of Mexico Loop Current, other ocean fronts, eddies, and representative sea surface temperatures.



Several images are used to prepare a single OFA. The chart on page 37 is the **North Panel OFA** derived from the images observed on about May 22, 1991, including the image below. The resolution of image data used in the analysis varies from 1 to 8 km.

After production, the OFA charts are faxed daily to the National Climatic Data Center for distribution to users. The OFA is available for 3 months, 6 months, or 1 year via subscription land fax and subscription mail. Prices vary depending on the chart and duration. There is a small fee for receiving by fax, one time, 1 to 5 charts. For more information on the chart cost, contact:

NOAA/National Climatic Data Center
Federal Building,
Asheville, NC 28801-2696
Attention: Subscriptions
or call (704) 259-0619.

The **North Panel OFA** is also

...Stream (labeled GS) appears as a band of warm water flowing northeasterly from Cape Hatteras to an area south of Nova Scotia. The meanders (waves in the Gulf Stream) almost always pinch off east of 70°W forming clockwise circulating warm eddies (WE) north of the Gulf Stream and counterclockwise circulating cold eddies (CE) south of the Gulf Stream. Warm and cold eddies generally move about 2 km/day to the west or southwest, while Gulf Stream meanders propagate downstream. Continental Shelf water (SHW) is cooler than the adjacent continental slope water (SLW) and long, warm water filaments are sometimes formed (GS/SLW is Gulf Stream water mixed with continental slope water). Also, warm eddies moving west or southwest eventually are confined between the 200 meter or 100 fathom curve and the Gulf Stream. These eddies are usually absorbed by the Gulf Stream near 36°N 74.5°W and leave a characteristic long, warm filament. The numbers on the chart are sea surface temperature (SST's) in degrees Celsius (C) from ships, expendable bathythermographs (XBT), buoys, and satellite digital data retrievals.

The legend appears in the upper left corner of the charts. It contains the abbreviations for Gulf Stream (GS), warm eddy (WE), cold eddy (CE), continental shelf water (SHW), continental slope water (SLW), Loop Current (LC), Labrador Current (LAB), and Sargasso water (SAR), which is warm Sargasso Sea water found south of the Gulf Stream. A solid line (–) indicates frontal location and arrows (→) indicate flow direction, not the current axis of the Gulf Stream or eddies.

available to ships at sea via radiofacsimile transmission from the National Weather Service Forecast Office in Boston. The frequency is 7530 kHz and the chart is transmitted at 1730 UTC daily. For more information contact:

National Weather Service
Forecast Office
Massachusetts Technology Center, Suite 102N
Logan International Airport
Boston, Massachusetts 02128

The Gulf Stream Wall Bulletin is directly derived from the OFAs. It is a series of latitude and longitude points that, when plotted and connected, describe the north wall position of the Gulf Stream. This bulletin is available through several sources. One is the Coast Guard radio broadcast from Portsmouth (NMN), VA transmitted at 1600 UTC and 2200 UTC on single side band frequencies 6501, 8764, and 13089 kHz.

Questions regarding information on or interpretation of the OFA should be directed in writing to:

NOAA/NOS/OPC
5200 Auth Road
Room 100
Camp Springs, MD 20746
or call (301) 763-8294
or (301) 763-8030.

Was Weather a Factor in the Oceanos Sinking?

Ian Hunter
South African Weather Bureau

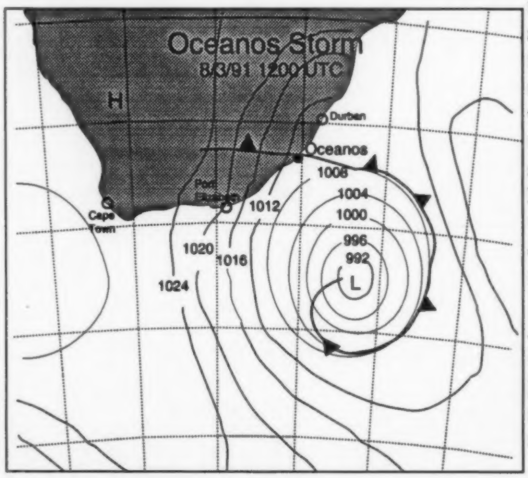
This article originally appeared in the South African Shipping News and Fishing Industry Review, Vol. 46 No. 4, 1991. We thank them for their permission to use it. Also contributing to the story were Mark R. Jury and Frank Shillington, Oceanographic Dept., University of Cape Town and Ocket Malan of the Forestek, CISR, Stellenbosch.

The Greek passenger liner ***Oceanos*** sank on August 4 at 1330 UTC at 39°09' S, 29°06'E, which is 4 miles offshore in 100 meters of water. Wind and wave conditions were extreme and several other ships in the area suffered damage, lost containers overboard or reported storm conditions.

A major incident involved the 357,000 dwt Norwegian tanker ***Mimosa***, which suffered heavy weather damage some 20 miles south of Cape Receife. The 317,354 dwt laden tanker ***Settbello*** after losing power in high seas, also suffered damage to her deck piping. The 9,780 dwt bulk carrier ***Lydia***, loaded with coal, was 100 miles off Port Elizabeth when seas carried away part of the canvas covers for the steel hatch covers. One crewman was injured while trying to retrieve the canvas. The Mossgas production platform, off Mossel Bay, recorded winds in excess of 100 knots and 23-meter swells.

Peak winds reported by ships in the area on Saturday, varied from 50 to 70 knots...

A low pressure system with a central pressure of 992 to 988 millibars was moving eastward, south of the continent. Satellite images and drifting weather buoy data suggest that the low had already undergone development.



The ***Oceanos*** storm slowed near 30°S, 33°E while a high pressure ridged toward Marion Island. The isobaric pattern formed concentric rings around the low and limited the fetch length for swell production to about 250 miles.

The eastward motion of the storm also limited the duration to about 12 hours. However, with reported surface winds of 60 knots, the estimated swell was 12 meters (40 feet) at the Oceanos' position.

The gust front associated with the cold front moved extremely fast, covering the distance from Port Elizabeth to Durban in less than 12 hours–a speed of 33 knots. It is significant that this is roughly the group velocity with which the longer-period (15 second) swells would have propagated up the southeast coast, causing an apparent increase in duration.

The South African Weather Bureau receives the products of two numerical weather models, the European

Satellite Data Services Division

This visual satellite photograph was taken on August 3 at about 1240 UTC. At this time, the shot nearly coincides with the analysis on the preceding page. This was about 10 hours before the first messages of distress were received from the Oceanos.

Centre Medium-range Weather Forecasting (ECMWF) model and the EGRR model of the British Meteorological Office, for guidance in developing daily weather forecasts. These models ingest the latest observational and satellite data, but in the case of the ***Oceanos*** storm the ECMWF model could only predict a weak low pressure south of Agulhas 48 hours in advance.

The EGRR model predictions of surface wind strength and distribution are important since they drive the only wave prediction model available to the South African Weather Bureau. The EGRR weather model was less successful than the ECMWF in that it placed the vortex for Saturday afternoon too far south and weakened the system as it moved eastward. Significantly, the model predicted a strong rise in pressure in back of the low, which leads to cold air over the warm Agulhas Current and sudden increases of atmospheric and oceanic turbulence.

...under westerly wind conditions mean speeds increase from 20 to 50 knots from the cooler coastal waters to the shelf edge...

As with the model guidance, the South African Weather Bureau forecasts lagged the actual observations, with a gale warning incorporated by Saturday evening (August 3d) and a swell prediction of southwest 6-8 meters.

Peak winds reported by ships in the area on Saturday varied from 50 to 70 knots from the west southwest, coincident with an estimated swell of 14 meters. None of the coastal meteorological stations in the vicinity of East London revealed gale force winds. Hence, a lack of representative marine weather stations on which to base detailed predictions of extreme sea conditions is evident.

Sea surface temperatures in the region of the Oceanos storm varied from 20° to 22°C and were no doubt responsible for the survival of the people from the water. One person was picked up 10 hours later, and another 8 miles southwest of the Oceanos– proof of the rapidly-flowing Agulhas Current.

A sea surface temperature map constructed from satellite measurements on August 5, showed the warmest patch of water was southwest of East London, and could have contributed to the atmospheric and oceanic turbulence in the region upstream from the site of the sinking.

After Mallory's study of abnormal waves off the South African southeast coast, recent research over the Agulhas Current from aircraft, ship and satellite all reveal a sharp build-up in sea-state off the southeast Cape coast. Reteach aircraft surveys south of Port Elizabeth in June 1989, showed that, under westerly wind conditions, mean speeds increase from 20 to 50 knots from the cooler coastal waters to the shelf edge, where sea surface temperatures increase from 15° to 23°C in the Agulhas Current.

Atmospheric turbulence, which imparts swell-producing drag on to the ocean's surface, increases sharply over the Agulhas Current through the mechanism of heat exchange. Most importantly, wind directions converge and focus on the Agulhas Current in sea-breeze-like fashion.

In 1976, E. H. Schumann reported from scientific measurements that wave energy could increase four-fold within the Agulhas Current near Durban. **This means a doubling of wave height**

Die Burger, Cape Town

The weather system responsible for the damage shown in this photo was not quite as dominant as the Oceanos Storm. Surface pressure analyses show a vortex of moderate intensity passing south of the sub-continent on the 28th and 29th of August (the ship was damaged late on the 29th). Wind speeds measured on the coast were generally below 25 knots. Unfortunately there were no voluntary observing ship reports during the period of interest. Pressures from a drifting weather buoy are the only indication of a rapid intensification of a low pressure system. Buoy 17825 dropped 13 millibars in 6 hours on the 29th, indicating that the suspect vortex was not only closer to the coast than analysed—but was also significantly deeper. Earlier pressure analyses do not suggest any significant, distant fetch region.

Although this can hardly be labeled a case study, it does have something to say to the marine forecaster:

- Take your land-bound wind reports with a pinch of salt—particularly at night, in winter.
- Make every effort to obtain the maximum number of reports possible from vessels plying your waters.
- When it comes to wave generation, beware the rapidly developing low pressure system—no matter the size.

Just as a matter of interest, the repairs conducted in Cape Town involved the complete removal of the bow and strengthening of the collision bulkhead. The Atlas Pride finally sailed for Singapore with her speed restricted to a mere 7 knots.

Camera Care

Michael Halminski
Photographer

A basic consideration that every photographer must face is the type of film to use. In general, there are three categories to pick from–black and white negative, color negative, and color transparencies, or slides. Often this decision is based upon the intended purpose of the photographs.

The choice between black and white and color is often one of personal preference or application. Some shooting requires only black and white as an end product. Black and white photographs can also have a *purist* or artistic effect. A good black and white photograph is not only effective, but also difficult. Color can often hide a multitude of sins, but you can't hide from black and white. When properly processed, black and white has a longer life, since it is more resistant to fading than color. However, color negatives can easily be printed on black and white paper that is especially designed to preserve the detail in the gray scale. So, you can have your cake and eat it too, to a degree.

Today most photographers, amateur and professional alike, are using color films. Most popular are the color negative films, which vary in ASA ratings or film speeds as mentioned in a previous article. Films can be purchased with ratings of 100, 200, and 400 and can be *pushed* higher. There are trade-offs, however. The higher the number, the more grain will be apparent in the final print. I tend to use the slower films for that extra crisp detail. This also allows for beautiful enlargements, up to 11x14 inches or 16x20 inches, without too much grain. When the end product is a color print, it is probably best to use color negatives, since they have built in qualities that give a print a pleasant color and contrast. Prints from these negatives are called type C prints.

One of my goals as a working photographer is to sell my images through publications, brochures and stock photography. All these avenues require the use of color transparency films. This not only makes editing easier, but they are also easier to store. I use bins with drawers to store slides according to category, and, when I'm going to edit or send some to a client, I slip them into polyethylene pages that hold twenty mounted slides. My preferred transparency films are Fujichrome 50, and Kodachrome 64.

Using slides presents a problem when prints are needed, and a good part of my livelihood involves selling prints out of my gallery. It is much more difficult to make prints from slides than from negatives. This is known as a direct positive process and results in something called a type R print or another popular more expensive print, called a Cibachrome. The problem arises when the subject has a wide range of densities; that is with bright highlights and shadow detail together. It is a problem of a technical nature and a resulting print will have an increase in contrast that either makes the highlights too *hot* or the shadow detail too dark, or both. Subjects of medium contrast print reasonably well. For example, a slide shot on an overcast day resulting in a low overall contrast will print quite well. The other alternative is to have an internegative made of the slide and then a regular type C print made with no contrast problems.

So choose your film to suit your needs. Experiment with negatives, slides and different film speeds, and use what is most comfortable. From negatives, you may want a photo album for presentation purposes and with transparencies you can entertain or bore your friends with slide shows.

The original photograph was taken using Kodachrome 64 slide film. The contrast differences are evident in the highlights of the white water of the breaking waves, and in the shadow areas in the clumps of grass and fence pickets. The middle tones of sand are less affected. The photo above is a type R print made directly from the original slide. This shows a high contrast with details in the highlights somewhat washed out, while shadow details are dark. Below, the type C print, made via an internegative made from the original slide, reveals a lower contrast with much more detail in the highlight and shadow areas. Photographs by Michael Halminski.

The *Ernestina*

Steve Fatjo
National Weather Service

Recently, the ***Ernestina***, a 106-foot schooner owned and operated by the Commonwealth of Massachusetts, joined the Voluntary Ship Observing Program while temporarily moored in Miami, Florida. The ship has a colorful past and is a welcome addition to the VOS program.

For nearly 100 years, the ***Ernestina*** has been fishing the Grand Banks, plowing the seas between New England's ports and Europe, exploring the Arctic, keeping the Cape Verde Islands replenished with food and cruising the Atlantic Coast during four separate and distinct careers.

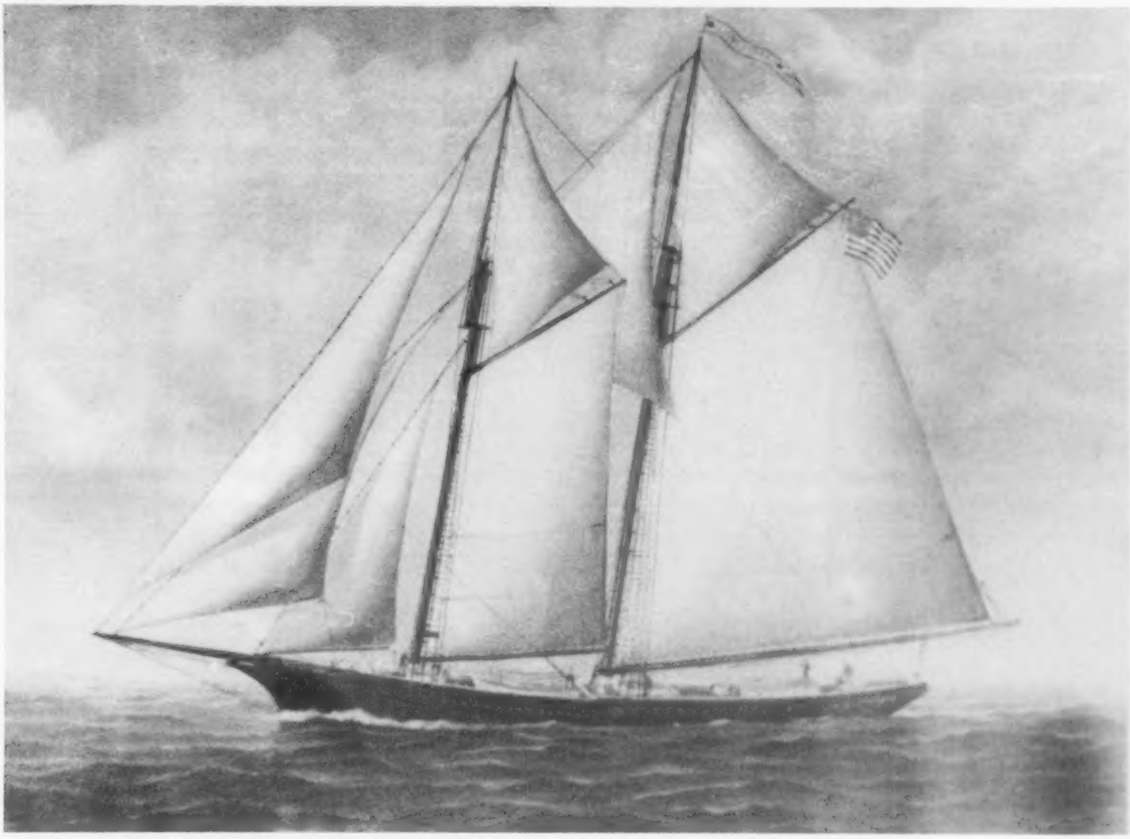
The sailing ship, first launched by James & Tarr at Essex, Massachusetts in 1894, was originally named the ***Effie M. Morrissey*** for the daughter of her first captain, William M. Morrissey of the Gloucester fishing fleet. George M. McClain based her design on the innovative ***Fredonia*** model, which combined a seaworthy, narrow, deep hull with the clipper bow and lofty rig of the unstable *Gloucester clippers* of the 1850s through 1880s.

Her first career began in the mid 1890s when she was used primarily as a salt banker, fishing the Grand Banks for cod. In winter, she fished off Newfoundland for herring and in summer, did some mackerel seining, too. She was sold to new owners in Nova Scotia in 1905, but kept her American registry. In 1914, she was sold to Harold Bartlett of Brigus, Newfoundland who worked her for 12 years as a British fishing vessel. He, in turn, sold her to his brother, Captain Bob Bartlett, who had sailed with Robert Peary on a number of his expeditions to the Arctic.

Her second career began in 1926 when Captain Bartlett sheathed her hull in greenheart and installed an engine. Sponsored by the Smithsonian, the American Museum of Natural History and the U.S. Navy, among others, Bartlett gathered zoological specimens and completed coastal and hydrographic surveys in unchartered Arctic waters. On one voyage, the ***Effie M. Morrissey*** was within 600 miles of the North Pole–a record for sailing vessels of its size. During World War II, Captain Bartlett operated her as an Arctic supply and survey ship for the Navy. Following Captain Bartlett's death after the war, she was purchased as a yacht, but soon caught fire and was scuttled.

Her third career as a Cape Verde packet began in 1948, when Henriques Mendes of the Cape Verde Islands had her raised and refurbished her in New Bedford, Massachusetts–the heart of the Cape Verdean community in America. He removed her engine and placed her into the passenger and freight service that had been established, in 1892, between the islands off the coast of Africa and New England. Renamed ***Ernestina*** after Mendes' daughter, she made the 3,000-mile journey, under sail, between the islands and Providence, Rhode Island for more than 25 years.

The ***Ernestina*** was retired about 1975. Taken over by the new Republic of Cape Verde, she was rebuilt to participate in Operation Sail in 1976. Enroute to New York she was dismasted, and the following year the Cape Verdeans gave the vessel to the United States–a symbol of the historic ties between the two countries. In August 1982, she returned to New Bedford, Massachusetts where she underwent an extensive 4-year



*The **Ernestina** formerly the **Effie M. Morrissey** according to Captain Dan Moreland: "exemplified the best of the Fredonia-type Gloucestermen–the finest working fore-and-aft sailing vessel with a design that felicitously combined speed, carrying capacity, maneuverability, sea kindness and elegance in a balance that is rarely achieved." These ships were capable of 12 to 14 knots and typically brought in more than 20,000 pounds of fish. The photograph was based on a beautiful color painting by Jeff Eldredge, 1988.*

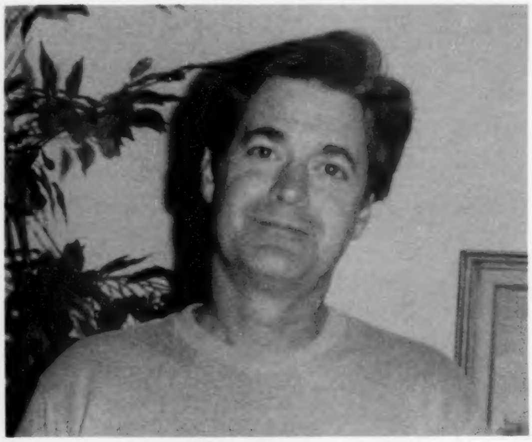
refit, which ended in time for her to participate in Operation Sail in 1986. She was unique in that parade of ships as the only vessel to have actually carried immigrants to this country. In 1987 she received the National Trust for Historic Preservation's Preservation Honor Award. Operated by the Commonwealth of Massachusetts, her home is now New Bedford.

She is currently a sailing school ship, museum ship and cultural ambassador for the Commonwealth. Her stay in Miami resulted from too close an encounter with Hurricane Grace in October, 1991.

Pelican Joins VOS Program

We are pleased to welcome the Louisiana Universities Marine Consortium and their research vessel the *Pelican* to the VOS Program.

Getting to Know Your PMO



John Warrelmann, PMO
New Orleans

John (Jack) Warrelmann has been in the PMO program since 1989. He is a native of Bound Brook, New Jersey and served for 24 years in the Marine Corps, where he specialized in weather observing and forecasting. Since retiring from the Marines in 1984, he has worked in the Air Force weather records center in Asheville, North Carolina, was a weather briefer and forecaster at Tyndall Air Force Base in Florida and with the National Weather Service at Key West, Florida.

MWL: John, has your Marine Corps background helped you in the Port Meteorological Officer job?

John: Yes, in the fact that the Marines have a lot of expeditionary weather equipment designed for mobility and the ability to set up and be operational in a short period of time. The equipment is very similar to that found on modern ships.

MWL: Have you found much of a difference between the ports of Newark and New Orleans?

John: The cargo is different because Port Newark and Elizabeth primarily handles container vessels and car carrier traffic. In New Orleans there is less container and more lumber, pipe, produce, petro bulk and grain cargo. I haven't seen a car carrier here, but some farm machinery does move through the port.

MWL: Does the location of your office help or hinder your work?

John: My office is not co-located at the National Weather Service Forecast Office in Slidel, Louisiana, but is located at the International Airport some 15 miles west of New Orleans. This works out to be a good location since it is close to the Mississippi River, with the grain elevators and petro bulk facilities up-river and the port authority piers and industrial canal located down-river. I have been alternating days with direction, up and down the river, to try and catch the most shipping.

MWL: Do you have duties in addition to those of PMO?

John: Just the PMO duties since Moisant Field (International Airport) is an observational contract site. Therefore, I have not been taking observations like I often did while working at the Weather Service Office in Newark.

MWL: What type of ships and cargo are most common at the port?

John: A majority of the country's coffee bean imports arrive through New Orleans and a large amount of the Central American fruit crop arrives through the Gulfport and Biloxi facilities. There are a lot less VOS ships operating on a routine basis out of New Orleans. Most of the shipping is on a non-routine schedule and vessels may not return to New Orleans for months at a time.

MWL: Tell us a little about your family?

John: I have been married for 30 years and have two grown sons. My oldest, and his family, are in Hawaii. He is an electrician and works at the submarine base at Pearl Harbor. My youngest son and his wife reside in Wilmington, North Carolina, where he is in law enforcement.

MWL: Do you have any hobbies?

John: I enjoy gardening, reading and tinkering with cars. I also like to work on stained glass projects.

Pete Connors Retires

In the last issue we mentioned that Pete was retiring from the PMO program, in the MAROB column. However the PMOs wanted to give him an official sendoff as well. Peter B. Connors retired on January 24, 1992. He served the National Weather Service for 37 years, the last 14 years as a Port Meteorological Officer in the ports of Port Arthur, Texas; Jacksonville and Miami, Florida.

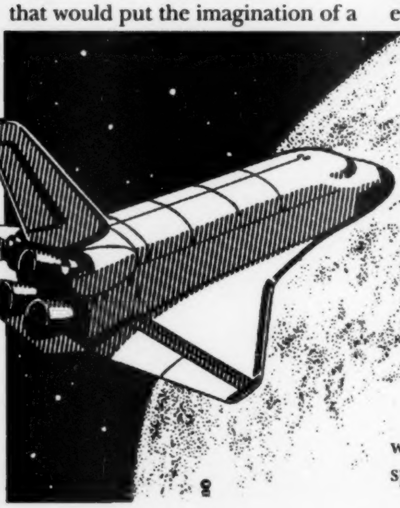
Pete (right) is holding a brass barometer and plaque given to him by the National Weather Service Marine Observations Program Branch in Silver Spring, Maryland in honor of his many years of service as a PMO. Douglas L. Davis (left) NWS Southern Region, Chief of Observations and Facilities Branch is holding Pete's plaque. In a small retirement ceremony, Doug read a letter from the NWS Southern Region Director, Harry Hassel, thanking Pete for his many years of service to his country and the National Weather Service. Steve Fatjo (right), the new PMO for the southern Florida region, was also present.

Houston PMO Jim Nelson returns with a vengeance this issue. Can you spot him in the three pictures above and in the middle photo? Actually, he is handing out some well-deserved observing awards. Above left, representing the ***Overseas Harriet*** *is Captain F. S. Wanamaker. Above middle for the AMOCO International fleet are Captain F.A. Milanesio, manager (left) and Captain G. Guarracino, Master. Above right, is Captain Steve Williams, Master of the* ***Overseas Marilyn,*** *receives an award on behalf of the Maritime Overseas Corp., and in the center Captain Mark Sladen, Master of the* ***Chesapeake Trader.*** *Below left, receiving a 1990 award for the* ***Sea-Land Pacific*** *are Captain A. Karl Jaskierny, Master, (right) and Vessel Operations Manager David C. Johnson. Below center, Captain Ratcliff accepts on behalf of the owners, officers and crew of the M/V* ***Polynesia*** *the 1991 National Ocean Service "Top Ten Award" presented by dapper Steve Cook of the NOS SEAS Program. Below right, SEAS also presented some caps to the Virginia Port Authority Operations Section (left to right), Ernie Dunn, Tom Martin and Bland Creekmore. Doing the presenting were Jim Farrington of SEAS and Norfolk PMO Ray Brown.*

Serene Fury

Mario Runco, Jr., Astronaut
NASA (photographs by NASA)

The Earth with all its political turmoil, bustling enterprise and parade of weather systems looks quiescent and beautiful from space. The various hues of blue and red are striking to the human observer so dependent upon the visual sense. From 195 nautical miles, the blue planet belies its activity. Traveling at mach 25 (25,000 feet/second) or 17,500 mph, we orbited the Earth every 90 minutes. The breathtaking views were countless as we sped past snow-covered mountains, seemingly endless coastlines and cloud formations that would put the imagination of a 6-year old on overtime. There were towering thunderstorms, Von Karmen vortices, positive vorticity maxima, jet streams and a host of other weather features; but none was so striking and dominating as Super Typhoon Yuri in the western Pacific. Over 1000 miles across and covering the entire planet within our field of view!



Having spent some time at sea onboard USS *Nassau* and USNG ***Chauvenet***, and knowing how violent the sea can get, I could imagine the rage that Yuri was unleashing as we silently floated overhead. At its peak, we estimated that the storm was packing sustained winds of at least 150 knots. Even at 5 miles per second, it took us better than 5 minutes to traverse the storm. We were able to see almost directly down into the eye, which we estimated to be almost 100 miles across (about 1/10 the diameter of the entire storm). As we gazed, mesmerized, into Yuri's eye, we realized that we were looking at an eyewall that spanned approximately 35 to 45 thousand feet from the tops of the lower clouds to the top of the cirrus blowoff. We could plainly see the individual cells streaming upward along the rim of the eyewall. These cells, arcing forward in the direction of the midlevel circulation around the center, seemed to dance to their own choreography. Fortunately, Yuri spent its fury at sea and veered northward to cooler waters and to its demise. Save for the brief interruption in shipping, Yuri affected human activities little–or did it?

As our orbit count grew and our attention turned from the panorama that was Yuri to more detailed inspections, the planet's other activities became readily apparent. The breathtaking blue over many areas was absent, replaced by a murky brown haze, the telltale sign of industrial and agricultural burning activities. Much to my chagrin, it was quite prevalent around the globe. Having viewed the thin mantle of the atmosphere that sustains us all, I began to wonder how much more it can take before the system breaks down. In fact, has it not already? The ozone hole, global warming, and more severe El Nino's are just three manifestations of the tip of a

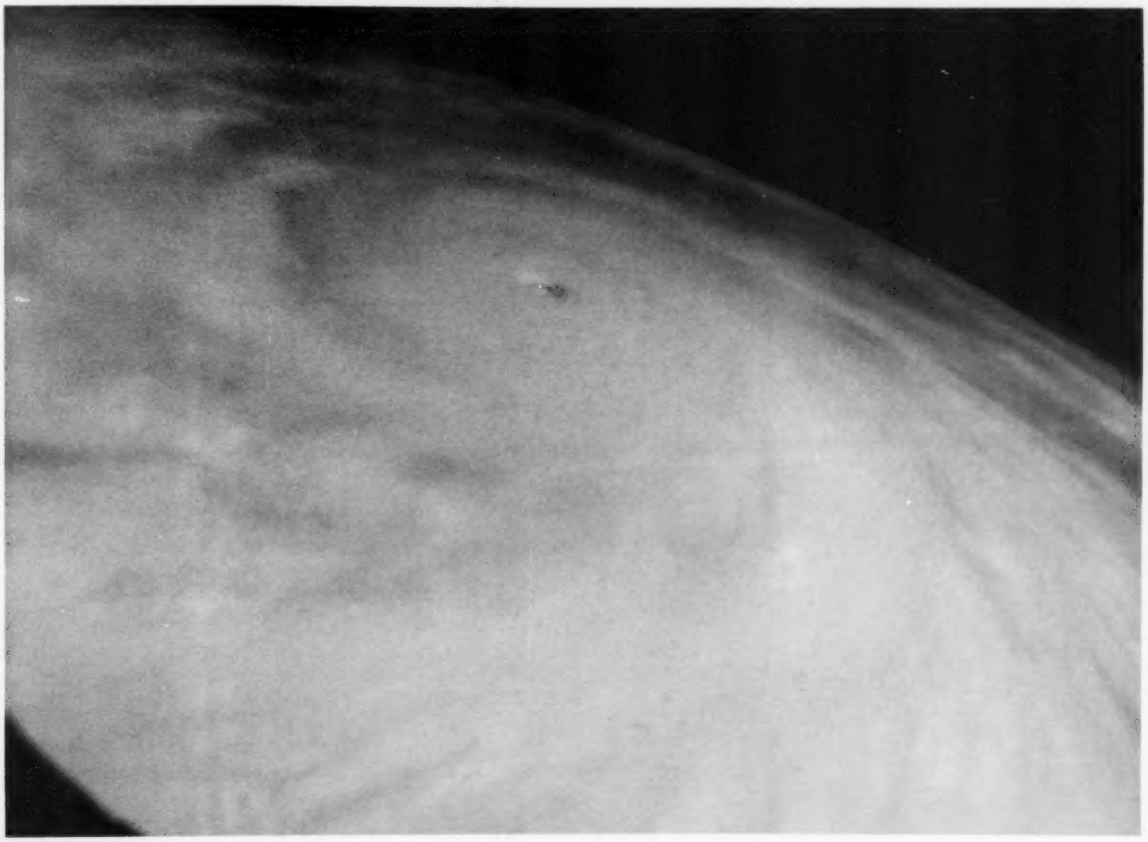
growing iceberg that is fast moving toward major shipping lanes. From one extraterrestrial observer's point of view, with more than a casual interest in the atmosphere, the handwriting seems clear.

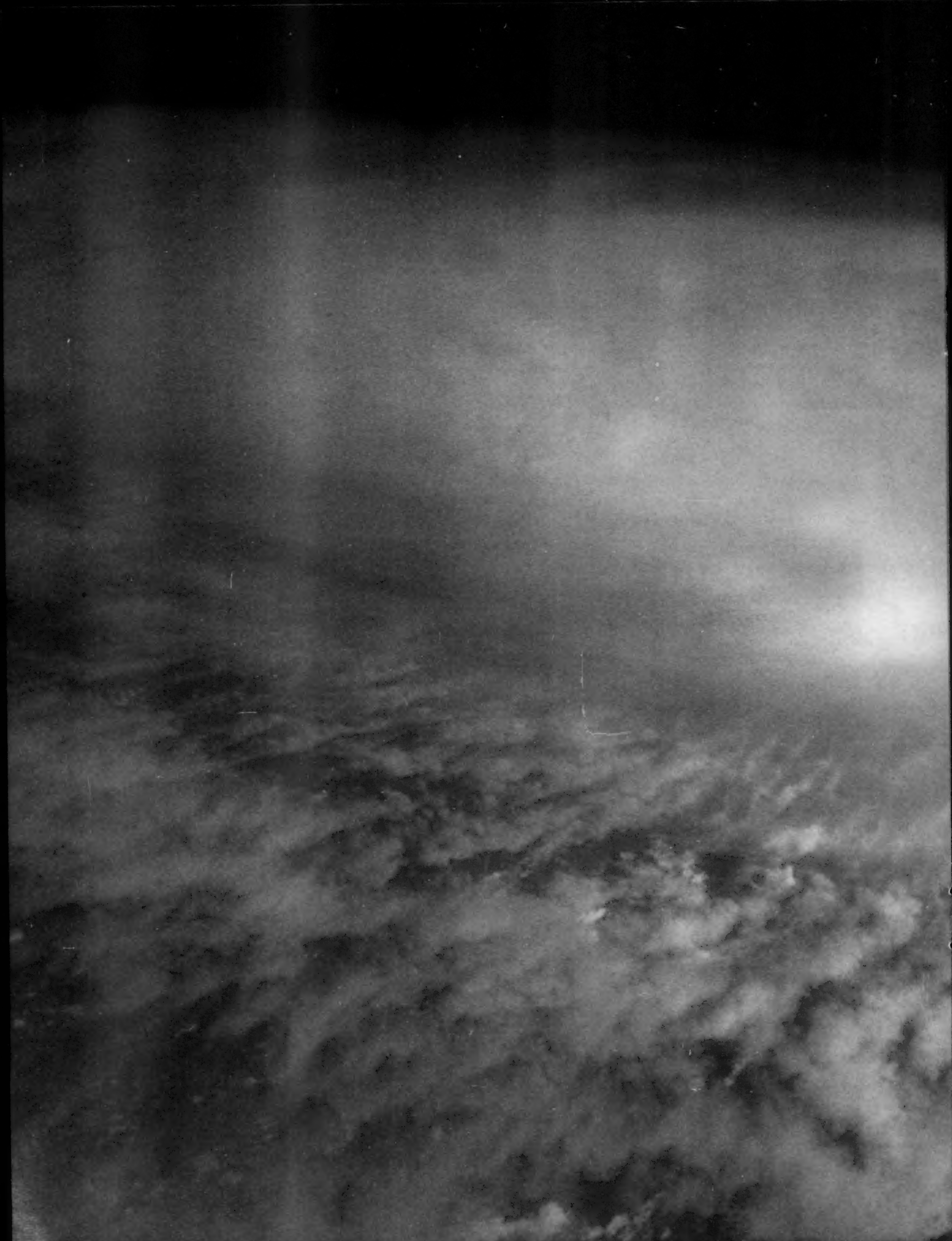
Great swaths of forest cover have already been removed and the deforestation along with the destruction of countless plant and animal species continues at an alarming rate. This is visible not only in the tropics but on our own continent as well. The tracts of denuded land grow larger in the photographs brought back from successive missions only months apart. On average, around the globe, there is an acre of forest land lost every second!

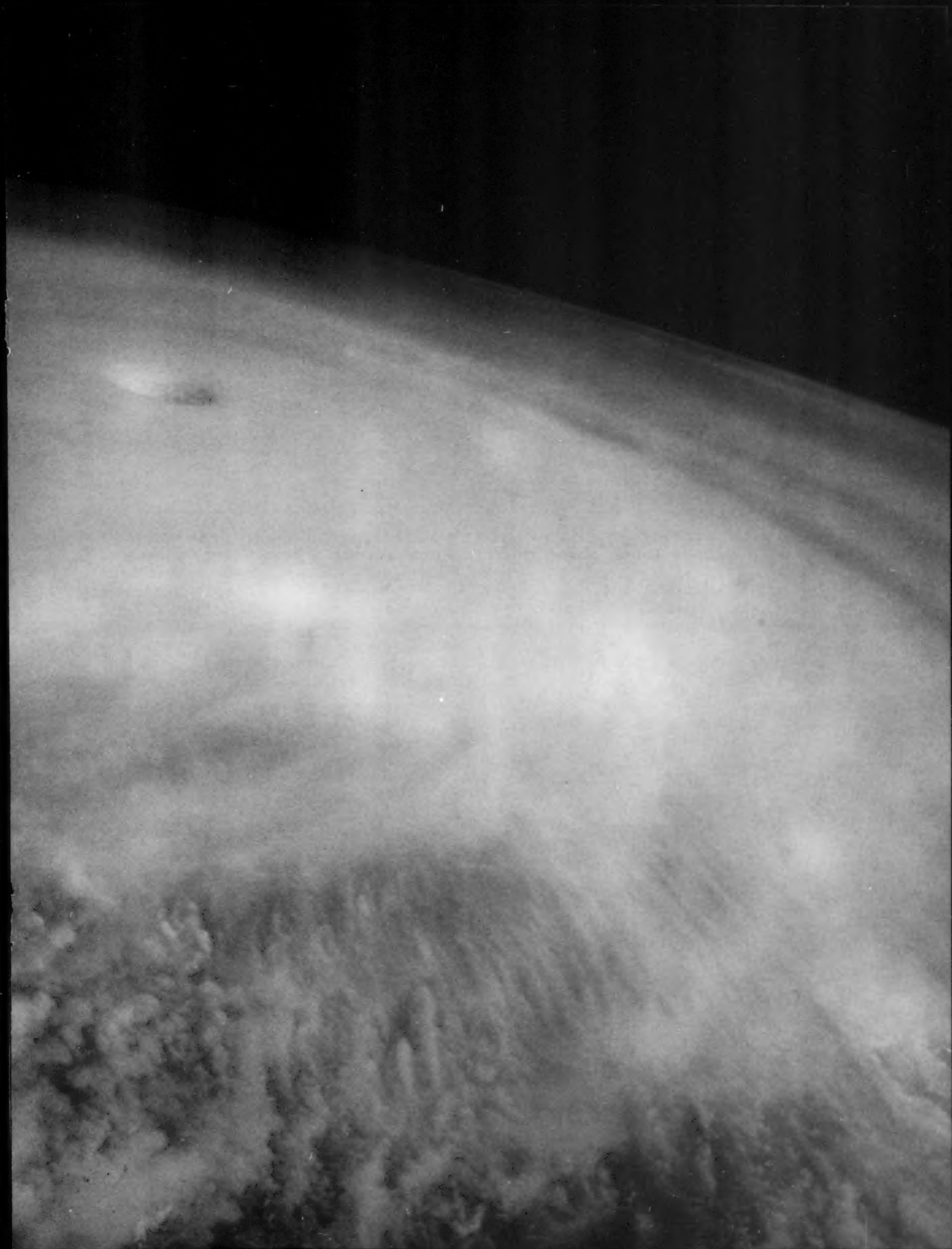
In spite of Yuri, these human activities strangely dominate the field of view. The question comes to mind as one floats peacefully over the planet; how are we going to sustain all of this? The only conclusion I can come to is that environmentally sustainable economies are indeed the key to our children's and their children's well being. All of our short term concerns about the economy seem to pale in importance compared to the concerns we will have about the economy of the long term. Any short term turnaround is doomed to failure if the basis of the recovery is not sustainable over the long run.

Yuri is an integral part in the way our planet keeps its thermal and climatic equilibrium. Human activities dependent upon this global balance (virtually all in one fashion or another) must also come into balance with what the planet will safely and sustainably allow. The human activities, the bustling enterprises that deplete our few remaining resources are luxuries we can no longer afford.

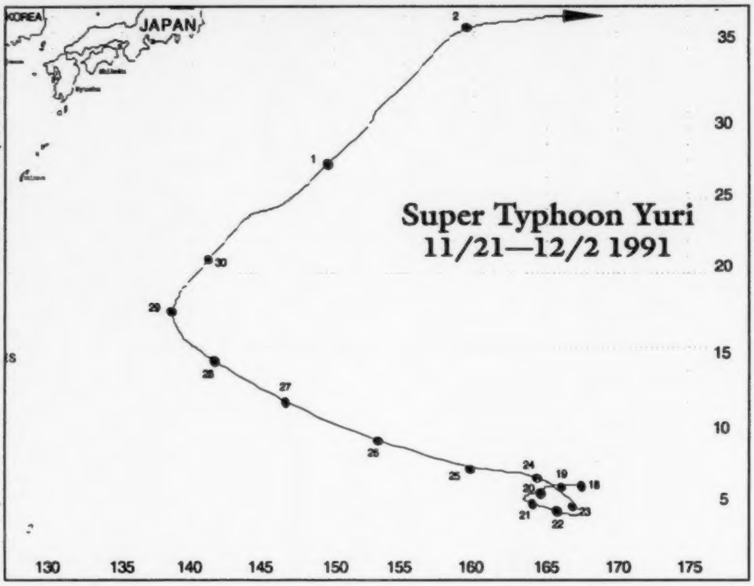
Over several successive days we were happily able to document Yuri's evolution and demise. In the brief lifespan of Yuri, I realized that we as a species may be permutating the balance that for millennia has allowed nature to sustain life on Earth. For the long term, there will be other Yuri's that rage over the planet, perhaps without observers to admire, study and document that which is manifestly dangerous and beautiful at the same time.



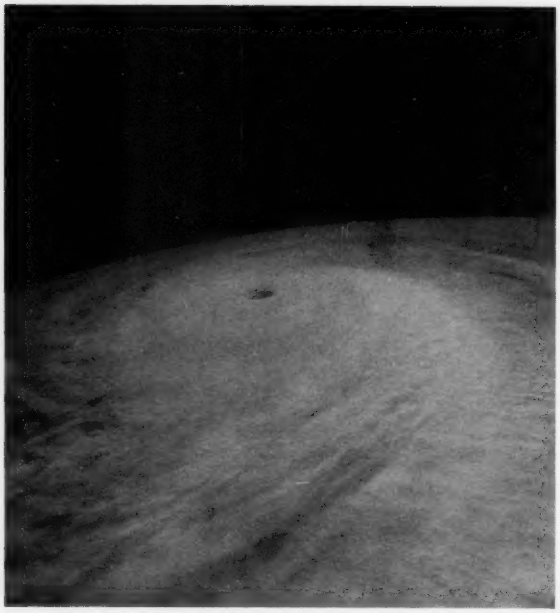


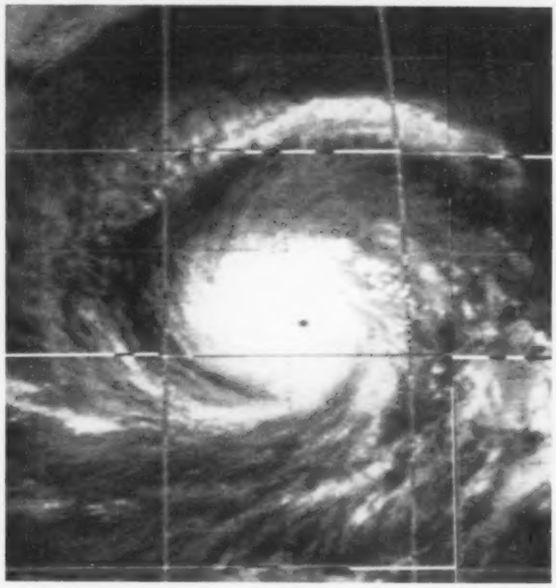


Yuri—Day by Day



Super typhoon Yuri was viewed by Atlantis, by GOES and tracked by the Joint Typhoon Warning Center on Guam. JTWC picked up Yuri as a tropical disturbance on the 16th of November. It became a tropical depression on the 18th and, after turning a counterclockwise loop, it reached tropical storm strength on the 23d, a day before Atlantis was launched. Yuri reached typhoon status on the 24th and super typhoon strength on the 26th. NASA's Atlantis saw the super typhoon at about 0330 UTC on the 27th (page 49) when winds near the eye were being estimated at about 150 knots–peak intensity. Yuri's eye passed about 60 nautical miles southwest of Guam at around 1100 UTC on the 27th. Winds over the southern part of the island were about 100 knots with gusts to 125 knots. When Atlantis came around on the 28th they were treated to a spectacular view (cover and pages 50-51). At this time, Yuri was beginning the familiar parabolic course and was slowing and beginning to weaken–if you can call 145-knot maximum winds weak. Below left, is a photograph of the eye of Super Typhoon Yuri on the 28th at about 0400. The wall cloud was estimated at about 25 miles in diameter on the 27th, but from space it appears it was larger. Below, right is another beautiful view of Yuri early on the 29th as it was in the process of recurving (see track chart). What a difference a day makes–the view on page 53 (left) is Yuri from Atlantis on the 30th, and while not nearly as photogenic, it was still generating winds of 100 knots. For comparison on page 53 (right) is a GOES satellite shot at about 0600 on the 27th, provided by the Satellite Data Services Division of NOAA. Yuri continued to weaken and became extratropical late on the 1st of December.



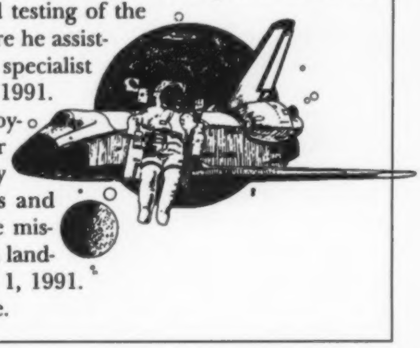


Meteorologist in Space

Lieutenant Commander Mario Runco, Jr. brought a unique vision to the Space Shuttle Atlantis Mission STS-44–that of a professional Meteorologist. As luck would have it, a super typhoon was their for the viewing.

Mario a native of the Bronx (New York) received a bachelor of science degree in Meteorology and Physical Oceanography from City College of New York in 1974 and then a master of science degree in Meteorology from Rutgers University in New Jersey. With a name like Mario, it shouldn't seem strange that he played ice hockey in his college days. After completing training at the New Jersey State Police Academy, Mario worked as a New Jersey State Trooper until he entered the Navy in June 1978. Upon completion of Navy Officer Candidate School in Newport, Rhode Island, in September 1978, he was commissioned and assigned to the Naval Environmental Prediction Research Facility in Monterey, California, as a research meteorologist. From April 1981 to December 1983 he served as Geophysics Officer aboard the Amphibious Assault Ship USS *Nassau*. He was then assigned as an instructor at the Naval Postgraduate School in Monterey. In December 1985, Runco assumed command of Oceanographic Unit Four, embarked in the USNS *Chauvenet* to conduct hydrographic and oceanographic surveys of the Java Sea and Indian Ocean. After this tour, Mario was stationed at Pearl Harbor until his selection to the astronaut program.

Selected by NASA in June 1987, Runco qualified as an astronaut mission specialist in August of 1988. His technical assignments included assisting in the design, development and testing of the Space Shuttle crew escape system and at the Kennedy Space Center, where he assisted in preparing Space Shuttle missions for launch. Mario was a mission specialist on STS-44 aboard Atlantis, which launched the night of November 24, 1991. The primary mission objective was accomplished with the successful deployment of a Defense Support Program (DSP) satellite with an Inertial Upper Stage (IUS) rocket booster. In addition, the crew conducted two Military Man in Space experiments, three radiation monitoring experiments and numerous medical tests to support longer duration Shuttle flights. The mission was concluded in 110 orbits of the Earth with Atlantis returning to a landing on the lakebed at Edwards Air Force Base, California on December 1, 1991. With completion of his first mission Mario logged over 166 hours in space.



NOAA Weather Radio

Larry Peabody
National Weather Service

One of the most reliable ways of receiving specialized weather radio broadcasts, whether along the coast, on a lake or river, or on land, is through the National Oceanic and Atmospheric Administration's (NOAA) Weather Radio service. There are nearly 375 NOAA Weather Radio stations in the U.S. Approximately 90 percent of the nation's population is within listening range of a broadcast.

Originating from National Weather Service offices throughout the country, including Alaska, Hawaii and Puerto Rico, these broadcasts are quick,direct and are tailored to the particular region's needs.

For example, NOAA Weather Radio broadcasts in Mississippi, Iowa, and the lower Rio Grande Valley of Texas provide detailed agricultural forecasts emphasizing soil temperature, amount of sunshine and vegetation drying conditions during the planting and harvesting seasons. Broadcasts in Colorado, Utah and New Hampshire focus on winter weather and skiing conditions at nearby resorts, while stations adjacent to the Mississippi and Ohio Rivers routinely broadcast river stages and forecasts. NOAA Weather Radio locations along the U.S. coasts include wind speed and direction, sea and surf conditions, sea water temperatures and daily tide data with the regular forecast. Around the Great Lakes, broadcasts highlight the extent of ice formation, when relevant, as well as open water, near-shore and seasonal recreational forecasts.

In addition to routine weather forecasts and current weather conditions from the area, NOAA will interrupt to broadcast severe and winter weather watches and warnings, travel advisories, tropical storm and hurricane bulletins and other life-threatening weather information as required.

During unusual hot or cold spells, the heat stress index or wind chill factor will be added to the hourly weather summary. Often this is of special concern to mariners, fishermen, boaters or others who plan to be outdoors for an extended period of time.

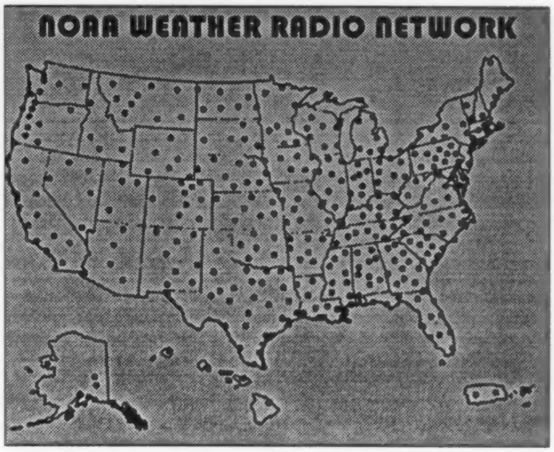
In the event of a natural disaster, such as a hurricane, or a man-made accident, like a hazardous substance spill, NOAA has been authorized to broadcast vital Civil Defense information to the public. Evacuation routes to be used, closures of bays and estuaries to commercial and sports fishermen, or catch restrictions on certain species within coastal and offshore waters are examples of the information relayed.

NOAA Weather Radio broadcasts on one of seven VHF-FM frequencies ranging from 162.40 to 162.55 megahertz (mHz). These frequencies are not found on the average radio. However, a number of radio manufacturers offer special weather radios that operate on these frequencies and some include an emergency warning alarm. Warning alarm receivers are especially valuable for schools, hospitals, public-safety agencies and news media offices. Also, there are now many radios on the market that offer standard AM/FM frequencies plus the so-called *weather band* as an added feature. This is even available on some car and boat radios.

NOAA Weather Radio broadcasts can usually be heard as far as 40 miles from the antenna site, and perhaps more. The effective range depends upon many factors, particularly the height of the broadcasting antenna, terrain, quality of receiver and type of receiving antenna. As a general rule, listeners close to or beyond the 40-mile

range should have a good quality receiver. An outside antenna may be required in fringe areas. The National Weather Service recommends the receiver be tried at its place of intended use before making a final purchase.

As a courtesy to travelers and campers the NOAA Weather Radio service has been installed at various tourist information centers, roadside parks and rest areas, and state and national parks around the country.



Radio Broadcast Changes

PRETORIA, SOUTH AFRICA

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
	4014 kHz	1530-0100	F3C	
ZRO2	7508 kHz	CONTINUOUS	F3C	8-30 KW
ZRO3	13538 kHz	CONTINUOUS	F3C	30 KW
ZRO4	18238 kHz	CONTINUOUS	F3C	30 KW

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
0405	ECMWF SURFACE ANAL	120/576	0000	
0430	UPPER AIR ANAL	120/576	0000	
0445	SURFACE ANAL (SHIPPING)	120/576	0000	
0505	FAX SCHEDULE	120/576		
0520	SURFACE ANAL (1) (2)	120/576	0300	
0630	ECMWF UPPER AIR ANAL	120/576	0000	
0710	10-DAY MEAN SEA SURFACE TEMP(3) (4)	120/576	-------	
0730	ECMWF SURFACE ANAL	120/576	0000	
0800	NORTHERN ICE LIMITS (ANTARCTICA)	120/576		
0920	ECMWF SURFACE	120/576	0000	
1000	SURFACE ANAL (SHIPPING)	120/576	0600	
1445	SURFACE ANAL (SHIPPING)	120/576	1200	
2200	SURFACE ANAL (SHIPPING)	120/576	1800	

NOTES:
1. SEAWARD ANALYSIS FOR PORTION OF AREA ONLY, DEPENDING UPON INFORMATION AVAILABLE.
2. BI-LEVEL CHART. ANALYSIS OVER CONTINENT FOR THE 850MB LEVEL.
3. ON MONDAY, WEDNESDAY AND FRIDAY. (EAST COAST)
4. ON TUESDAY, THURSDAY AND SATURDAY. (WEST COAST)

MAP AREAS: NOT AVAILABLE.

(INFORMATION DATED 04/1992)

NORFOLK, VIRGINIA, U.S.A.

CALL SIGN	FREQUENCIES		TIMES	EMISSION	POWER
NAM	3357	kHz	CONTINUOUS*	F3C	
	3731	kHz	(1)&	F3C	
	8000	kHz	CONTINUOUS&	F3C	
NAM	8080	kHz	(1)*	F3C	
	9318	kHz	CONTINUOUS$	F3C	
NAM	10865	kHz	CONTINUOUS*	F3C	
NAM	15959	kHz	0900-2100*	F3C	
	18245	kHz	(1)&	F3C	
NAM	20015	kHz	1200-2100*	F3C	

*** - NORFOLK FREQ & - THURSO FREQ $ - ICELAND FREQ**

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
0000/------	NFAX SCHEDULE	120/576		
------/1200	NMC BOUNDRY LAYER ANAL	120/576	0000	
0015/1215	36HR 850MB HT/TEMP/WIND PROG	120/576	00/12	
0030/1230	36HR 500MB HT/TEMP/WIND PROG	120/576	00/12	
0045/1245	48HR 500MB HT/TEMP/WIND PROG	120/576	12/00	
0100/1300	36HR SURFACE PRES PROG (S. ATL)	120/576	00/12	
0115/1315	48HR SURFACE PRES PROG (S. ATL)	120/576	12/00	
0130/1330	36HR 500MB HT PROG (S. ATL)	120/576	00/12	
0145/1345	48HR 500MB HT PROG (S. ATL)	120/576	12/00	
0200/1400	SATELLITE IMAGERY (GOES FULL DISK CH. 2)	120/576	---/---	
0215/------	NMC EXTENDED SURFACE U/A PROG	120/576	---/---	
------/1415	NMC 200MB ANAL	120/576	0000	
0230/1430	OPEN PERIOD			
0240/1440	RAFC 12HR SIGNIFICANT WEATHER PROG (FL250-600)	120/576	12/00	
0250/1450	NMC 36HR 500MB HT/ISOTACH PROG	120/576	00/12	
0300/------	NOEC GULF STREAM ANAL	120/576	LATEST	
------/1500	FNOC SST ANAL	120/576	LATEST	
0315/1515	NEOC 36HR PROG BLEND	120/576	00/12	
0330/1530	NWS RADAR SUMMARY	120/576	LATEST	
0345/1545	OPEN PERIOD (TROPICAL WARNINGS)	120/576		
0400/1600	500MB HT ANAL (S. ATL)	120/576	00/12	
0415/1615	FNOC PRELIM SURFACE ANAL (N. ATL)	120/576	00/12	
0430/1630	SURFACE TROP PRES/WIND ANAL	120/576	00/12	
0445/1645	SURFACE PRES ANAL (N. ATL)	120/576	00/12	
0500/1700	NMC 24HR NMG PROG	120/576	00/12	
0515/1715	SATELLITE IMAGERY (GOES GOMEX CH. 14)	120/576	LATEST	
0530/1730	BRACKNELL 24HR SURFACE PROG	120/576	00/12	
0545/1745	SATELLITE IMAGERY (GOES N. ATL CH. 15)	120/576	LATEST	
0600/1800	NMC 48HR NMG PROG	120/576	00/12	
0615/------	NWS RADAR SUMMARY	120/576	LATEST	
------/1815	NEOC SEA HEIGHT ANAL	120/576	1200	
0630/1830	850MB HT/TEMP/WIND ANAL	120/576	00/12	
0645/1845	700MB HT/TEMP/WIND ANAL	120/576	00/12	
0700/1900	500MB HT/TEMP/WIND ANAL	120/576	00/12	
0715/1915	300MB HT/TEMP/WIND ANAL	120/576	00/12	
0730/1930	12HR SURFACE PRES/WIND PROG	120/576	12/00	
0745/1945	SATELLITE IMAGERY (GOES GOMEX CH. 14)	120/576	LATEST	
0800/2000	24HR SURFACE PRES/WIND PROG	120/576	00/12	
0815/2015	48HR SURFACE PRES/WIND PROG	120/576	00/12	
0830/2030	NMC 24HR SIGNIFICANT WEATHER PROG	120/576	00/12	
0840/2040	NMC 36HR/48HR SIGNIFICANT WEATHER PROG	120/576	12/00	
0850/2050	OPEN PERIOD (TROPICAL WARNINGS)	120/576		
0900/2100	24HR SIGNIFICANT WAVE HEIGHT PROG	120/576	00/12	
0915/2115	SURFACE PRES ANAL (PRELIM)	120/576	06/18	
0930/2130	24HR 200MB HT/TEMP/WIND PROG	120/576	00/12	
0945/------	BRACKNELL 48HR SIGNIFICANT WAVE PROG	120/576	0000	
------/2145	NEOC 84HR PROG BLEND	120/576	1200	
1000/2200	NEOC 12HR HIGH SEAS/WIND WARNINGS	120/576	00/12	
1015/2215	24HR 850MB HT/TEMP/WIND PROG	120/576	00/12	
1030/2230	24HR 700MB HT/TEMP/WIND PROG	120/576	00/12	
1045/2245	24HR 500MB HT/TEMP/WIND PROG	120/576	00/12	
1100/2300	24HR 400MB HT/TEMP/WIND PROG	120/576	00/12	
1115/2315	SATELLITE IMAGERY (GOES N. ATL CH. 15)	120/576	LATEST	
1130/2330	24HR 300MB HT/TEMP/WIND PROG	120/576	00/12	
1145/2345	24HR FREEZING LEVEL PROG	120/576	00/12	

NOTES: 1. ON CALL VIA COMMSPOT. (INFORMATION DATED 04/1992)

Coast Guard Communications Survey

We are trying to do a good job! Are we? Tell us what is important to you and indicate where we need to improve. We may discontinue some services based upon your response. In the boxes at the right, place a number from 1 to 9, one being poor service and 9 being great service. Use 5 if our Communication Stations are providing the service just as good as the average station with which you communicate. Add a + or – sign if you perceive the service to be currently improving or degrading. A ✔ beside the service indicates that it is especially important to you.

Atlantic Coast and Gulf of Mexico

NMF Comm. Station BOSTON	#	±	✔
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF CW Broadcasts			
MF CW Broadcasts			
HF FAX Broadcasts			
2670 kHz Voice Broadcasts			

NMA Communication Station MIAMI			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
MF CW Broadcasts			

NMR Comm. Stn.San Juan PR			
NAVTEX Broadcasts			

Pacific Ocean Areas

NMC Communication Station SAN FRAN			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF Radio TELEX			
MF CW Broadcasts			
HF FAX Broadcasts			
HF Voice Broadcasts			

NMO Communication Station HONOLULU			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF CW Broadcasts			
MF CW Broadcasts			
HF Radio TELEX			
HF Voice Broadcasts			

Coastal Services

ATLANTIC VHF CHAN 16 guard			
ATLANTIC VHF Voice Broadcasts			
ATLANTIC 2182 kHz Voice Guard			
ATLANTIC 2670 KHZ Broadcasts			

Atlantic Coast and Gulf of Mexico

NMN Comm. Stn.PORTSMOUTH	#	±	✔
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF Radio TELEX			
MF CW Broadcasts			
HF VoiceBroadcasts			

NMG Comm. Station NEW ORLEANS			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
MF CW Broadcasts			

Pacific Ocean Areas

NOJ Comm. Station KODIAK			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF Radio TELEX			
MF CW Broadcasts			
HF FAX Broadcasts			
HF Voice Broadcasts			

NRV Communication Station GUAM			
500 kHz services			
Single Side Band voice			
NAVTEX Broadcasts			
SITOR Broadcasts			
HF CW Broadcasts			
MF CW Broadcasts			
HF Radio TELEX			
HF Voice Broadcasts			

Coastal Services

PACIFIC VHF CHAN 16 guard			
PACIFIC VHF Voice Broadcasts			
PACIFIC 2182 kHz Voice Guard			
PACIFIC 2670 KHZ Broadcasts			

NAME/UNIT ______________________________

FOLD ALONG DOTTED LINES AND SEAL EDGE WITH TAPE

U.S. Department
of Transportation

United States
Coast Guard

2100 Second St. SW
Washington DC 20593

Official Business
Penalty for Private Use $300

Postage and Fees Paid
U.S. Coast Guard
DOT 514

First Class Rate

COMMANDANT (G–TIM)
U.S. COAST GUARD
2100 2ND STREET SW ROOM 6302
WASHINGTON DC 20593–0001

FOLD ALONG DOTTED LINES AND SEAL EDGE WITH TAPE

Gulf of Alaska Gale

Norman M. Johnson
MREO, S/S ***Kainalu***

Gentlemen,

I always enjoy your fine magazine and read it cover to cover every chance I get. The story of the ***Central America*** *sinking and treasure salvage in the summer '91 issue was completely engrossing. (And the back cover very informative– I did not know that the GPO sold gold ingots. Now I know what they are doing with all the money they are exhorting from us for charts!).*

The story about Boston Light brought back memories of my teenage years in Winthrop, Massachusetts. Living in the third story of a house just 15 feet from the seawall, our dinning room had a panoramic view of Boston's outer harbor. The two lighthouses of the Graves and Boston Light were major landmarks. I had often dreamed of seeing them up close and now, thanks to you, I have.

When I saw that great photo on page 40, I noticed that you asked for photo submissions from seamen. While I do not have a picture to submit, I did write a description of my experience in a gale in the Gulf of Alaska last winter aboard the S/S President Madison. We left Seattle on Sunday afternoon the 26th, I believe, and were into it right away. It was one of the roughest passages I have ever made since going to sea in 1967. It was the first trip for the Skipper, Captain William McKinley, and we really caught hell. In addition to abundant but relatively minor damage, a structural part of the ship, a large box beam about 2x4 feet around, was broken and had to be repaired by shipyard personnel in Japan. We finally did make it to Dutch Harbor and after we headed south for Yokohama, the weather gradually moderated until we were in sunshine and smooth sailing again.

Gulf of Alaska
November 30, 1990

Wind and wave roar with unmeasurable power. Ship and sea collide several times a minute and each enormous impact sends vibrations ringing from bow to stern like an earthquake. At 10 cycles per 8.5 seconds, the storm shakes us in its mighty fist.

For the past 5 days we have been sailing among the high latitude winter gales of the North Pacific. Since we left Seattle for Yokohama, by way of Dutch Harbor, in the Aleutians, we have been staggering through a breathtaking world of primeval power and grandeur.

On the bridge, the Captain, the Mate on watch, the Quartermaster behind the wheel and I watch the wind speed indicator caress 60 knots. Our 600-foot containership, the S/S ***President Madison***, normally capable of cruising at 23 knots, with her 20,000-horsepower steam turbine, averaged this day only 4.4 knots, just enough to maintain steerageway. To attempt to go any faster would be to invite structural damage.

Unrestrained gales hammer upon the house and scream through the steelwork and rigging of the ship, which sets up a terrific howling. The entire vessel rings to this thunderous song.

I stare hypnotically through the forward windows of the wheelhouse at the incredible scene on the other side of the glass.

Thirty-foot seas march from horizon to horizon. White breaking crests fly from wave tops, while streaks of foam cloak their flanks. They roll under and crash against the vessel, tossing us the way a child would toss a ball. Sometimes the timing of the waves and the period of gyration of the ship come together and the ship rises, higher and higher out of the water, until her bow points toward the sky. The bridge is silent as 30,000 tons of ship leaps into the air and comes crashing down into the oncoming sea. A huge mass of water rises up over the bow 450 feet ahead and is flung straight back at us like flak at incoming bombers during World War II. We all watch silently as the ship undulates uncontrollably.

After the storm, the ship seems so huge and solid alongside the dock, so massively indifferent gliding through the harbor. It is a shock to be reminded of the reality of her fragility.

NOAA's Pacific Buoy Arrays

Earl R. Hinz

Peoples of the Pacific will certainly remember the disastrous weather of 1982/83 when El Nino reared its ugly head and created severe droughts in Australia, Indonesia and southern Africa, while producing torrential rains in California, along the Gulf Coast, Peru, Ecuador and Bolivia. For the mariner it resulted in fluky winds over much of the Pacific and an unheralded number of tropical cyclones in the Pacific's best cruising grounds: French Polynesia. It was disaster at its worst and totally unpredictable at the time.

Although we still cannot do anything but talk about the weather, scientists are measuring the daylights out of the sea and atmosphere over the tropical Pacific in hopes of at least developing a technique for predicting the onset of another El Nino. There was an El Nino Oscillation Advisory issued in February 1990 based on limited data recorded east of the International Date Line, but by April, winds and surface water temperatures had returned to normal and it was canceled without any adverse atmospheric events. There are sporadic signs of one in the making at the present, but who can be sure?

The 1982/83 episode caught the attention of the world's meteorologists and oceanographers and many countries decided to do something about it. Among them were China, France, Japan and the United States. Because of the large data collection area involved and the amount of data that had to be handled, the individual country's efforts were melded into one all-inclusive research program–the Tropical Ocean-Global Atmosphere program (TOGA), coordinated through NOAA's Pacific Marine Environmental Laboratory at Sand Point in Seattle, WA.

One aspect of the research program, which is of great importance to mariners, is the scheme for obtaining subsurface and surface water and atmospheric data. It involves the placement and monitoring of 65 data buoys called Autonomous Temperature Line Acquisition System (ATLAS) reaching from the Galapagos to New Guinea along the equator. The first were put in position in 1984 and 1985 and the array is still being filled in. There were 17 buoys in place at the end of 1990; five more to be planted in the eastern Pacific and four more in the western Pacific in 1991 and the rest to be planted so that the array is complete by 1993.

You may have thought that Light Lists, up-to-date charts and Notices to Mariners would have advised you of the existence of these buoys–not so. This bit of information seems to have fallen in a crack between NOAA and the U.S. Coast Guard. There has been no systematic effort by NOAA to make the positions of these buoys available to mariners who might encounter them at sea.

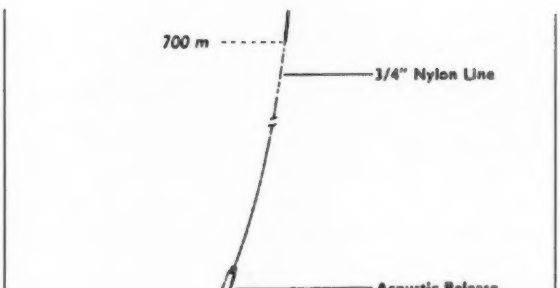
The ATLAS buoys which make up the array are marvels of electronic and mooring technology. The buoys are 7.5-feet diameter toroids made of fiberglass over a foam core and painted with orange and white bands. An aluminum tower approximately five meters high supports the instrumentation. The weight in air of the fully-equipped buoy is approximately 500 pounds. Now for the startling aspect of these buoys–some are moored in water as deep as 20,000 feet! The mooring system consists of 2300 feet of .36 inch diameter wire rope with the remaining section of .76 inch nylon rope. The mooring sinker weights a hefty 20,000 pounds.

Each buoy is equipped with a standard instrumentation package which measures water temperature from the surface down to 1640 feet. An anemometer measures wind speed and direction and other sensors measure air temperature and humidity. All these data are stored on board the buoy and transmitted on command to an Argos transponder-equipped satellite that relays them back to earth for processing by the meteorological and oceanographic communities. Electric power is furnished by solar panels with battery storage backup.

While we wait for the scientific community to evolve its El Nino prediction system, we have to keep in mind that these 65 buoys may constitute navigational hazards. They most certainly are navigational hazards if the mariner is not aware of them. NOAA may or may not have given thought to telling the mariner where these high tech buoys are. Maybe they thought the navigation hazard was less than the risk of pirate mariners who, if they knew where they were, would seek them out and purloin or damage the equipment.

NOAA was not oblivious to the possibility of a collision for they equipped each buoy with a radar reflector and a flashing light. Vandalism has already taken its toll of radar reflectors and lights. It is highly unlikely that boats would be using radar continuously in their passages in order to take advantage of the buoys. Ships may, although there has been much conjecture lately on whether ship radars are monitored continuously outside of shipping lanes.

The amount of damage that a 500-pound buoy could do to a steel ship is probably insignificant. The amount it could do to a small fiberglass sailboat may be



This is a schematic diagram of the ATLAS wind and thermistor chain mooring. These systems are deployed in deep ocean in water up to 20,000 feet deep. These buoys are part of the TOGA-TAO (Tropical Atmosphere-Ocean) Array and are the result of an international effort to provide a basin-wide real-time observing system.

ensure some degree of freedom and safety for voyagers on the high seas.

If you do see an ATLAS buoy in your voyaging, take a picture of it, but leave it alone. Remember, it is there to provide warning of one of Nature's most disastrous and least understood phenomena.

NOAA's Response

The letter describing the TOGA-TAO array, which Mr. Earl Hinz submitted to the Mariners Weather Log is misleading in its representation of the location of the TAO buoys. These buoys are noted in the local Notice to Mariners #7 (February 15, 1992).

–Dr. Stanley P. Hayes
Director, TOGA-TAO Project

Mr. Hinz originally wrote this letter for the January/February issue of Ocean Navigator, so it is apparent that NOAA had not notified the boating public before these buoys came to the attention of Mr. Hinz.

–ed.

Codes, Awards and Reminders

Martin S. Baron
National Weather Service

Weather Group Indicator (i_x) for Present/Past Weather

The sixth group of the Ships Synoptic Code ($i_R i_x hVV$) contains the code figure i_x, which is the indicator for the present/past weather group, $7wwW_1W_2$. The only function of i_x is to indicate if significant weather is being reported, and whether $7wwW_1W_2$ is included in the weather message (ww is weather at the time of observation or during the past hour; W_1W_2 is past weather since the previous main synoptic hour). When there is significant weather, $7wwW_1W_2$ should be included in your weather message, and i_x is coded as 1; if there is no significant weather to report, $7wwW_1W_2$ is omitted from the weather message, and i_x is coded as 2. **Code figure i_x only refers to weather group $7wwW_1W_2$ – it provides no information about the presence of any other groups. The following weather phenomena are considered to be without significance :**

For ww (present weather):

- 00 - cloud development not observed or not observable
- 01 - clouds generally dissolving or becoming less developed
- 02 - state of sky on the whole unchanged
- 03 - clouds generally forming or developing

For W_1W_2 (past weather):

- 0 - cloud covering 1/2 or less of the sky throughout the appropriate period
- 1 - cloud covering more than 1/2 of the sky during part of the appropriate period and covering 1/2 or less during part of the period
- 2 - cloud covering more than 1/2 of the sky throughout the appropriate period

When these conditions (weather phenomena without significance) are observed, they are recorded on the Ships Weather Observations form B-81, but not included in the transmitted weather report (group $7wwW_1W_2$ is omitted).

Updated Worldwide Marine Radiofacsimile Broadcast Schedules now available

Worldwide Marine Radiofacsimile Broadcast Schedules, updated through February, 1992, were mailed to all ships in the National Weather Service (NWS) Voluntary Observing Ship (VOS) program on April 2, 1992. Additional copies are available from NWS Port Meteorological Officers (PMOs). The publication includes the radio stations, broadcast times and frequencies for a wide variety of products, including marine surface and upper air analyses, weather prognostications (progs), oceanographic analyses, and satellite imagery and products. The publication has six separate sections, covering broadcast schedules from Africa, Asia, South America, North and Central America, Europe, and Antarctica/South Shetland Islands.

Reminder: Always Include Synoptic Code Section 0 (groups 1-5) in Your Weather Message

Section 0 consists of the first 5 code groups starting with the BBXX indicator. There is no meteorological or oceanographic data here. It identifies your report as a ship's weather report, and locates your vessel in time and place. Never slash out data or omit any groups in section 0 – it's a mandatory section to be included in every weather report. Only data in sections 1 and 2 (groups 6-21 and ice data) can be omitted, when not available, in two ways, 1) by using the slash mark (/), or 2) by omitting entire groups from the message (never transmit a group as /////).

Exception: the first group in section 2, $222D_sv_s$ must be included whenever any section 2 groups (marine and ice data) are present.

Synoptic Code Section 0 (report identification, ship position data) – Mandatory For All Weather Reports

BBXX D.....D $YYGGi_w$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

Please see the Marine Observation Program column either in the Fall 1991 or Winter 1992 Mariners Weather Log, or the July 1991 edition of NWS Observing Handbook No. 1, Chapter 3, pages 3-1 through 3-7, for more details on coding section 0.

Hurricane Season Approaching

The Northern Hemisphere hurricane season runs from May to November, and peaks in August and September as the tropical oceans (from about 8° to 20° North Latitude) reach their annual temperature maximums. For the Southern Hemisphere, hurricane season is November to May.

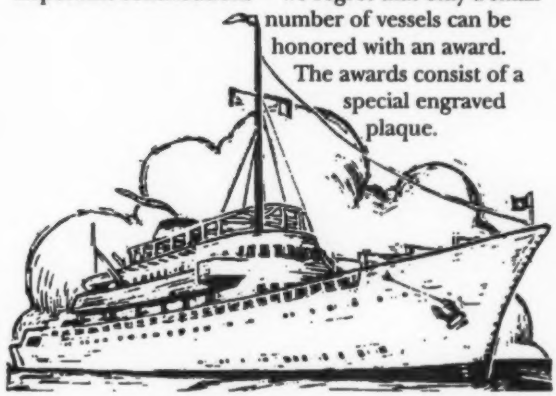
NWS meteorologists keep a close watch on marine areas during hurricane season for signs of tropical storm development, and closely examine all available data. Special (SPREP) and STORM (STORM) reports from your vessel are particularly important this time of year. Send a SPREP at any time to alert the NWS to weather that has not been forecast, or that is much worse than forecast. Send STORM reports at three hourly intervals if your vessel is within 300 miles of a named tropical storm or hurricane. Include the SPREP or STORM indicators as separate groups following the BBXX indicator in the weather message. Examples:

BBXX SPREP (coded weather message beginning with call sign) Wind Gusts to 70 Knots;

BBXX STORM (coded weather message beginning with call sign) Hurricane Emily Force 12 Gust 92 knots

Voluntary Observing Ship Awards For 1991

We are pleased to announce that 34 Voluntary Observing ships and 5 shipping companies will receive outstanding performance awards for observations and support during 1991. Congratulations! To make the selections, PMO's submitted the names of the very best and most conscientious vessels/shipping companies to NWS Headquarters, where the final decisions were made. All Voluntary Observing Ships make important contributions – we regret that only a small number of vessels can be honored with an award. The awards consist of a special engraved plaque.



Shipping Companies

American President Lines
Lykes Brothers Steamship Co.
Maersk Line
Sea-Land Services, Inc
Transports Maritima Mexicana

Vessels

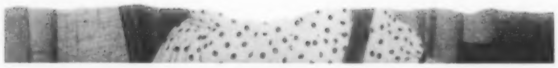
Atlantic Ocean	*Polynesia*
Calcite II	*President Harrison*
Edwin H. Gott	*President Polk*
Ferncroft	*President Washington*
Golden State Bridge	*Puritan Dhou*
Great Land	*Rainbow Hope*
Joseph H. Frantz	*Sea-Land Acheiver*
Maersk Pine	*Sea-Land Enterprise*
Matsonia	*Sea-Land Pacific*
Maui	*Sea-Land Producer*
Merida	*Sea Lion*
NOAA Ship Discoverer	*Sea Merchant*
NOAA Ship Oregon II	*Sea Wolf*
NOAA Ship Whiting	*Sedco BP 471*
Newark Bay	*Stewart J. Cort*
Nosac Takayama	*USCGC Acushnet*
Oleander	*USCGC Sweetbriar*
Paul R. Tregurtha	*Pennsylvania Trader*

and international circuits. Prior to codes and code standardization, lack of consistency in the reporting of observations posed enormous problems for the meteorologist.

The worldwide weather reporting schedule for VOS is four times daily – at 0000 0600, 1200, and 1800 (UTC), and every three hours when within 300 miles of named tropical storms or hurricanes. The United States and Canada have a special three hourly coastal waters reporting schedule, from within 200 miles of the United States or Canadian coastlines, including the coasts of the Hawaiian Islands and Alaska. Three hourly reports are also requested from the Great Lakes. Send Special or Storm reports at any time, when appropriate. The reporting schedules are indicated on pages 1-3 and 1-4 of NWS Observing Handbook No. 1.

Sympathy Message

We were sad to learn of the passing away of Seattle PMO, Dave Bakeman's wife, Lorraine, on March 9, 1992. Lorraine was a very special person with numerous pen pals from all over the world, including VOS ships. She was blessed with a large family that included her husband, David, sons John, David, Jay, Jeff, Jim and



Lorraine Bakeman

New Recruits January - March, 1991

PMO's recruited 36 vessels for the Voluntary Observing Ship (VOS) program from January through March of 1991. Thanks for joining. The NWS VOS program consists of over 1600 vessels, which report weather using the World Meteorological Organization code FM 13-IX, the Ships' Synoptic Code. Over 10,000 ship's officers participate as observers each year.

The importance of surface reports from ships cannot be exaggerated. Without these reports, weather forecasting over the vast marine areas would not be possible. Over land areas, surface data acquisition is financed and supported by many different federal, state, and private agencies. There are over 1600 weather reporting stations operating throughout the United States alone. Over the oceans, moving ships are the only pragmatic source of data – Data Buoys and Ocean Weather Stations are extremely expensive to operate and maintain, and are deployed in the most critical areas (usually coastal).

NATIONAL WEATHER SERVICE VOLUNTARY OBSERVING SHIP PROGRAM NEW RECRUITS FROM 01-JAN-92 TO 31-MAR-92

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
AMERICAN VETERAN	WEZT	COASTAL BARGE CORP	SEATTLE, WA
AUTOMOBIL ACE	3EVF8	WILLIAMS, DIMOND & CO	SAN FRANCISCO, CA
CAPE INSCRIPTION	WSCJ		HOUSTON, TX
CARIBBEAN EMERALD	DVAM	NATIONAL WEATHER SERVICE	LOS ANGELES, CA
CARNIVALE	C6KD	CARNIVAL CRUISE LINES	MIAMI, FL
CHOYANG FRONTIER	3EKY7	SOUTHERN STEAMSHIP	LOS ANGELES, CA
COASTAL EAGLE POINT	WHMK	COASTAL TANKSHIPS U.S.A.	HOUSTON, TX
COLLEEN SIF	OUVV2	BRANDTSHIP USA,INC.	NEW ORLEANS, LA
DOCTOR LYKES	3ELFP	LAVINO SHIPPING	BALTIMORE, MD
DOCTOR LYKES	3ELF9	LAVINO SHIPPING COMPANY	BALTIMORE, MD
DON JORGE	3EUO5	% TGM SHIPPING AGENCY	HOUSTON, TX
ERNESTINA	WTK7000	SCHOONER ERNESTINA	MIAMI, FL
EVER GRAND	3EFM3	EVERGREEN MARINE CORP	NEWARK, NJ
EVER GUEST	BKJH	EVERGREEN INTERNATIONAL	NORFOLK, VA
FLEMMING SIF	OUQP2	BRANDTSHIP USA,INC.	NEW ORLEANS, LA
GLOBAL SENTENIAL	WRZU	TRANSOCEANIC CABLE SHIP	HONOLULU, HA
GOLDEN APO	DUZH	K-LINE AMERICA, INC	SEATTLE, WA
HAWAIIAN EXPRESS	3EYS7	LOTT SHIP AGENCY	JACKSONVILLE, FL
KRAS	J8DS9	INT.SHIPPING &CHARTERING	SEATTLE, WA
LA TRINITY	H9BV	INTERSEA OPERATION LTD	NEW ORLEANS, LA
MAYVIEW MAERSK	OWEB2	MAERSK LINE	SAN FRANCISCO, CA
NOBLE ACE	DZAQ	TRILINES SHIPPING INC	JACKSONVILLE, FL
OBO ENGIN	TCEY	MARTI SHIPPING &TRADING	LOS ANGELES, CA
OCEAN ORCHID	DUGX	KERR STEAMSHIP CO.	SEATTLE, WA
PELICAN	WSK3051	LOUISIANA UNIVERSITIES	NEW ORLEANS, LA
THOMAS G. THOMPSON	KTDQ	UW, SCHOOL OF OCEAN.	SEATTLE, WA
TSL BOLD	DHZD	STEVENS SHIPPING CO.	JACKSONVILLE, FL
TSL BRAVO	P3IU4	STEVENS SHIPPING CO.	JACKSONVILLE, FL
USCGC ACUSHNET WMEC 167	NNHA	USCGC ACUSHNET (WHEC 167)	SAN FRANCISCO, CA
USCGC FARALLON (WPB 1301)	NABK	USCGC FARALLON (WPB 1301)	MIAMI, FL
USCGC GALVESTON ISLAND	NRLP	COMMANDING OFFICER	NEW ORLEANS, LA
USCGC JARVIS (WHEC 725)	NAQD	COMMANDING OFFICER	SEATTLE, WA
USNS ASSURANCE AGOS-5	NDPY	MASTER	SEATTLE, WA
USNS REDSTONE	NJAX	COMMANDING OFFICER	JACKSONVILLE, FL
WESTERN CRYSTAL	ELDR2	THE EASTERN SHIPPING CO.	NORFOLK, VA
YACU WAYO	OAPU	NAVIERA AMAZONICA PERUANA	HOUSTON, TX

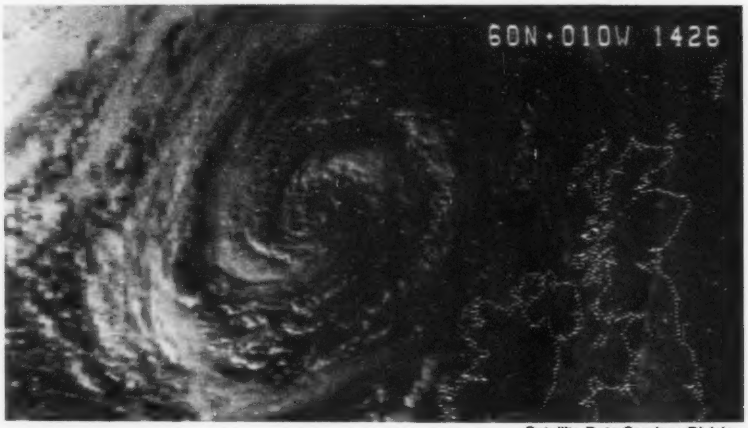
North Atlantic Weather October, November and December 1991

October– The most noticeable North Atlantic feature on the mean pressure chart was an intense high over Greenland, which produced positive anomalies of up to 12 mb. The Icelandic Low was weaker than normal as was the Azores-Bermuda High. However, there was no lack of cyclonic action in the North Atlantic this month.

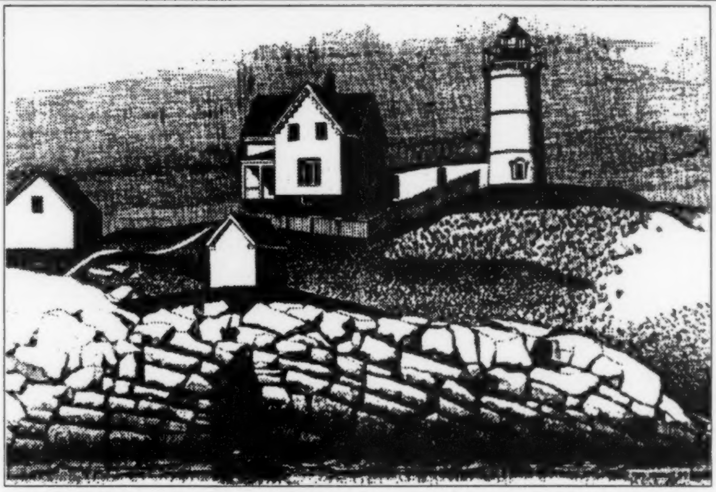
The month opened with a bang as one extratropical Low came to life off Florida and another was beginning to intensify near 45°N, 45°W. The northernmost system, which was at 1000 mb on the 1st, dipped to 956 mb by the 3d as it hugged the southeast coast of Iceland. This triggered a raft of gale and storm force wind reports in the Norwegian and North Seas. The worst came from the VETY (61°N, 17°W) which measured a 68-kn westerly in 24-ft swells with a 975-mb pressure. Other vessels caught in storm force winds on the 3d included the ***Grundarfoss, Laxfoss, Prikarpate, Arni Fridriksson, Cumulus, Kilkenny*** and the ***OOCL Assurance***. Most of the action was north of 60°N and east of 25°W. Conditions continued into the 4th but the storm was beginning to fill as it meandered northeastward.

However, it was replaced by the Florida Low on the 6th. Its central pressure also fell to 956 mb, near 59°N, 25°W at 1200. The ***Karpogory*** (56°N, 27°W) reported a 965-mb pressure at 1200. Winds were generally in the 40- to 50-kn range in swells of 15 to 20 ft. These conditions continued into the 7th as the system weakened and headed eastward.

The ***Canadian Progress*** encountered 38-kn northerlies in 11-ft seas on northern Lake Superior at 1800 on the 5th. A few hours later, the ***Edwin Gott*** and ***Arthur M. Anderson*** were clobbered by 40-kn westerlies while sailing northern Lake Michigan. About this same time a 993-mb Low was centered some 100 mi north northeast of Sault Ste. Marie, MI. Gales and near gales were also being reported over Lake Huron and portions of Lake Erie as the associated cold front passed through. The ***Cason J. Calloway*** ran into 45-kn west northwesterlies in 11-ft seas on northern Lake Superior. Other vessels reporting strong winds were the ***Wilfred Sykes, Stewart J. Cort, Presque Isle***



Satellite Data Services Division



While the Halloween Storm caused problems to vessels and numerous New England navigational aids, a storm off Ireland (pg 66) was affecting shipping in the eastern Atlantic. Lighthouses along the coasts of Maine and New Hampshire were hard hit. Above is the Cape Neddick Lighhouse along the Maine coast, courtesy of Paul Bradley, Jr.

and ***Edward L. Ryerson*** on Lake Michigan. The ***Murray Bay*** and ***Phillip R. Clarke*** also had it rough on Lake Huron as did the ***David K. Gardiner*** on Lake Erie. At 0600 on the 6th, the ***Edgar Speer*** reported a 38-kn wind on Lake Superior as the storm continued to make its presence felt.

A couple of minor Lows roamed the eastern half of the Atlantic during the second and third weeks, but the real fireworks did not occur until near the end of the month with Grace and the Halloween Storm.

On the 16th and 17th an intense 960-mb Low pounded the North and Norwegian Seas. Winds blew at 40 to 60 kn and seas of up to 25 ft were encountered. At 1200 on the 16th, a buoy near 55°N, 5°E reported a measured 60-kn south southwesterly and 3 hours later the ***Stena Felicity*** was mauled by 66-kn westerlies near 55°N, 5°W. The ***Haukur*** reported in with 68-kn northerlies farther north. Conditions remained bad on the 17th as seas in the North Sea were running over 30 ft and winds were measured at 60 kn in some areas. The North Sea and southern Norwegian Sea were boiling. At 1600 on the 17th, a buoy (61°N, 1°E) measured north winds at 62 kn, a 971-mb pressure and 26-ft swells. A drilling rig near 53°N, 4°E caught 65-kn winds in 20-ft seas. It wasn't until late on 18th that wind conditions dropped back to below storm force (50 kn).

At the end of the month, another storm, to the west of Ireland, was creating problems for shipping in the eastern Atlantic, while the Halloween Storm was plaguing western waters. For example, at 1200 on the 30th, the YJW6 (42°N, 65°W) measured a 60-kn north northeasterly, while the ***Kothen*** was running into 58-kn southwesterlies near 44°N, 17°W. Storm force winds kept up through the 30th in both storms. In fact, at 0000 on the 31st the ***Izola*** (40°N, 68°W) ran into 60-kn westerly winds in 32-ft swells. This was validated by the C6FA7 with 57-kn northerlies and 33-ft swells near 38°N, 73°W. On the other side of the Atlantic, conditions were improving temporarily as the ***Cumulus*** reported a 52-kn northeasterly near 58°N, 21°W at the same time. Three hours later her winds rose to 56 kn and she measured a pressure of 976 mb. Nearby, a buoy reported a 967-mb pressure reading and a 57-ft wave height. At 0600 the DWDH plowed into a 58-kn westerly near 42°N, 19°W and 6 hours later the ***Bonn Express*** measured 52 kn near 40°N, 73°W. Both sides of the ocean continued to be pounded as the month came to a close.

Casualties— The sailing vessel ***Anna Christina***, a 95-ft schooner with nine people aboard, reported it was unable to keep up with the flooding as a result of the severe weather generated by Hurricane Grace. From an Air Station at Elizabeth City, NC, an C-130 flew out to assist but was unsuccessful in dropping three pumps in 20-ft seas and 60-kn winds. Two Elizabeth City H-60 Helicopters were launched to evacuate the nine people onboard. The USS ***America*** was within 175 miles of the ***Anna Christina*** so the helicopters were able to refuel enroute. One developed engine problems but the other was able to rescue all nine people onboard. The self-propelled semi-submersible drilling platform ***Ocean Bounty*** sustained damage after being struck by a huge wave in the North Sea. On the 16th, the German inland waterways vessel ***Bremen Hannus*** sprung a leak near Urk during gales when it hit a stone embankment. Gale and storm force winds disrupted oil operations in the North Sea on the 16th, 17th and 18th. One oil worker reportedly died when he was hit by a container after the rig was pounded by giant waves. The winds forced closing of several platforms on the 18th. The self-propelled, semi-submersible drilling

platform ***Borgny Dolphin*** broke loose east of the Shetland Islands for awhile. Men were evacuated on several platforms as winds reached 65 to 70 kn.

In the Halloween Storm the MFV ***Eishin Maru*** was fishing off Nova Scotia, where it took seas over the vessel, breaking wheelhouse windows, causing flooding and resulting in a loss of power steering. Finally it was able to limp into Halifax. The bulk carrier ***Eagle*** sustained heavy weather damage as it sailed from Savannah to Three Rivers as did the ***Star Baltic*** enroute to Boston from Curacao.

The Halloween Storm caused damage to several lighthouses along the coasts of Maine and New Hampshire according to the U.S. Coast Guard. Boon Island Light off the southern Maine coast and the Isles of Shoals Light off Portsmouth, NH were knocked out of commission. Waves up to 30 ft pounded the coast, flooding several Maine beach towns. PAC Greg Creedon said initial damage estimates to the two stations were $450,000. Boon Island light's electronic equipment and generator were damaged, doors were destroyed and about one-half of the shingles were torn off its roof. At Isles of Shoals Light, the generator hut, the boathouse and ramp, and a walkway were destroyed.

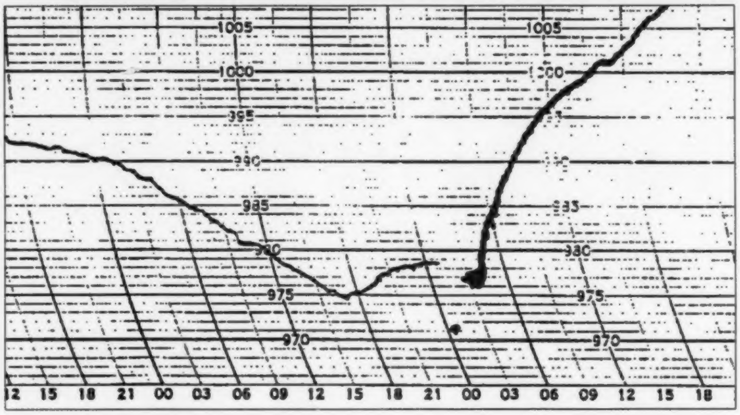
November– The Icelandic Low was much in evidence and deeper than normal, stretching from southwest of Iceland to northern Norway. This resulted in negative anomalies of as much as 8 mb in the Norwegian Sea. The Azores-Bermuda High was more intense than normal, particularly north of the Azores, as was the high over Greenland.

The month opened with a 969-mb Low from October still threatening ships with gale force winds and 15- to 20-ft seas over the North and Norwegian Seas. These conditions continued into the 3d as the center moved to just southwest of Bergen. The backlash resulted in gales westward to about 30°W, southward to the Bay of Biscay and southwestward to the Azores. On the 2d, storm force winds were being encountered by such ships as the OYSN2 (54°N, 29°W), the ***Seaboard Invincible*** (61°N, 1°E), the ***Maersk Giant*** (56°N, 5°E) and the P30B2 (67°N, 23°W).

This new Low produced a wicked early season snowstorm over the western Great Lakes. Late on the 1st its 990-mb center passed just west of Milwaukee, heading northward. By about 0800, gales were being experienced in some locations on Lake Superior and a few hours later they spread to Lakes Michigan, Huron and Erie. Vessels such as the ***Charles E. Wilson, Canadian Century*** and ***Phillip R. Clarke***, along with several land stations such as Long Pt, Ont, Alpena, MI, and St Joseph Coast Guard, MI, reported gales. It was apparent from these reports that the storm was most intense from about 0700 on the 2d to 0700 on the 3d.

By the 5th, a large double-centered 1030-mb High stretched across most of the northern North Atlantic with a moderate Low in the Denmark St. The Low meandered eastward, merged with another system, and on the 6th and 7th, affected shipping from the Denmark St to the English Channel as well as over the North and Norwegian Seas. In general, winds were running 40 to 50 kn and seas were in the 15- to 25-ft range. The LAXK2 sent in several fine reports. At 0000 on the 7th, near 56°N, 15°W, she ran into 48-kn westerlies in seas estimated at 30 ft. Rough conditions continued into the 8th.

After a slight lull, another storm intensified south of Iceland to create havoc over the northern shipping lanes. This system came to life on the 8th near 41°N, 66°W. After moving rapidly through the Gulf of St Lawrence as a rather weak, unorganized system, it began to strengthen. By 1200 on the 9th, south of Kap Farvel, its central pressure was 1004 mb and this



The Sea-Land Atlantic sent in this barograph trace, which was recorded from the 23d to the 25th of November as the vessel headed eastward from 31°W to about 10°W along the 48th parallel. A 965-mb Low was to the northeast of the vessel, when she recorded a 975-mb minimum on the 24th at about 1700.

plummeted to 960 mb some 24 hours later. This, of course, did not go unnoticed by ships and rigs in this part of the ocean. Wind reports of 40 to 50 kn became quite common on the 10th and several reports exceeded these values. The ***Rybatskaya Slava*** (60°N, 1°W), measured 52-kn winds in 10-ft seas at 1800 on the 10th and several buoys in the region reported 55- to 60-kn southwesterlies. ***The Maersk Dispatcher*** ran into a 50-kn blow near 58°N, 2°E. A report at 1200 from the OUEU (63°N, 20°W) indicated a measured northerly of 72 kn and a 978-mb pressure; this was just west of the center. Once past Iceland, the system swung northward but remained intense. On the 11th, seas of 15 to 25 ft were encountered east of the center. Winds remained in the 40- to 50-kn range as reported by such vessels as the ***Edouard L, Shetland Service***, GBXW and the ***Pholas***. A 974-mb secondary center was located to the southwest of Iceland as well. The whole system remained intact through the 14th, but was weakening as the primary center moved over northern Norway and the secondary over the British Isles.

On the 21st, a double-barreled system generated strong winds and rough seas over the shipping lanes in the north. A 968-mb Low was centered southeast of Greenland, while a 982-mb Low had moved over the eastern Norwegian Sea. This situation combined with a large 1034-mb High centered east of Gibraltar, was creating a tight pressure gradient over the northeastern North Atlantic and Norwegian Sea. By 0600 on the 21st, winds were blowing at 40 to 50 kn and seas up to 20 ft were reported in the North Sea. At 1800 on the 21st, the ***Kapitan Mochalov*** (65°N, 9°E) hit a 47-kn westerly in 17-ft swells. Conditions improved on the 22d.

On the 23d and 24th, a 1000-mb Low moved into the Great Lakes region bringing some rough weather to the area. Vessels such as the ***Canadian Century*** and ***Canadian Navigator*** were encountering 8-ft seas in gales on Lake Superior on the 23d. By early the following day, Lake Superior was being raked by 35-to 40-kn winds. On southern Lake Michigan, the ***Edgar B. Speer*** reported a 42-kn southwesterly in 10-ft seas at 0000 on the 24th. Both the ***Courtney Burton*** and ***Roger Blough*** on Lake Superior ran into 40-kn winds in 7-ft seas early that same day. By 0300 strong winds had spread to Lake Erie where the ***John B. Aird*** ran into a 34-kn southwesterly. After the center reached Sault Ste Marie at 1200 on the 24th, a secondary center seemed to develop as a frontal wave near Timmons, ONT. By the 25th, it was part of a 978-mb system crossing the St Lawrence River.

Once into the open waters of the Labrador Sea, it deepened even faster. By the time the storm passed just south of Kap Farvel, on the 26th, its central pressure dipped to 965 mb and gales were being felt from the coast of Labrador to the North Sea. At 0600 on the 26th, near 57°N, 58°W the UFVN encountered 43-kn north northeasterlies and measured a 970-mb pressure. The ***Neftegorsk*** (65°N, 3°W) at 1200 measured a 47-kn south southwesterly in 17-ft seas. Similar reports continued through the 27th as the storm headed into Iceland, sporting a 961-mb center. Most wind reports remained below storm force and seas stayed below 20 ft. The month came to a close with another double-centered system flanking Iceland and generating gales along the shipping lanes to the south. Over the Great Lakes, a 980-mb Low moved across eastern Lake Superior, generating gales over this lake and Lake Huron. At 1800 on the 30th, the ***Paul R. Tregurtha***, on Lake Huron, reported 45-kn west northwesterlies in 7-ft seas. The ***Phillip R. Clarke, Courtney Burton, Canadian Enterprise*** and ***Canadian Leader*** also ran into gales on Huron, while Buffalo, NY reported 45-kn winds on Lake Erie. Rough weather continued for several more hours as the system headed rapidly northeastward.

Casualties— The 79,681 dwt ore carrier ***Sonata*** sank in heavy seas off the Norwegian coast on the 14th. She was under tow at the time carrying 75,100 tons of iron pellets some 200 mi northwest of Vigra near Aalesund. All 24 members of the Polish crew were lifted to safety. A late October-early November Great Lakes bone-chilling snowfall stalled railyards at Superior and some vessels bound for Duluth and Superior had to be diverted. Two deaths were reported on land where drifts up to 15 ft were reported.

In the Mediterranean, during the night of the 23d-24th, southeast winds of 90 kn lashed the eastern and southern coasts of Italy, creating havoc with shipping in these waters. At Gela, the Mv ***Marta*** sank after breaking her moorings, but the crew was saved. Italian coast guard officials reported that dozens of pleasure boats sank at their moorings after being battered by high waves. Nine crewmen were reported missing after their fishing vessel ***Demetrio*** sank in heavy seas off the coast of Sicily. They were able to launch a liferaft. The ***Irini***, carrying 200 tons of fine flour, was driven aground near Gela, while the MV ***New Rose*** with a crew of 27 was also aground just west of Gela. The crew was rescued. The tug/supply vessel

Augustea Tre was blown aground on Sicily and her crew was rescued by helicopter.

December–The outstanding climatic feature for the month was a 1028-mb High centered over France, which resulted in anomalies of up to +14 mb just west of Ireland. It also left a -4 mb anomally hole across the Atlantic west of the Canary Islands. In addition it forced the Icelandic Low over the Labrador Sea creating a very tight gradient between Greenland and the British Isles.

A storm that developed over Virginia on the 3d, deepened rapidly as it moved through the Gulf of St. Lawrence the following day. By 1200 on the 5th its estimated central pressure had fallen to 946 mb from a 985-mb reading the day before. This storm was strong enough to generate gales over the shipping lanes west of about 50°W south to the latitude of Philadelphia. Some of the reporting vessels included the VCDT, *Gadus Atlantica*, 4XIO, *Ann Harvey* and *IL Rochette*. Winds were in the 50-kn range and seas were running 15 to 20 ft. Fortunately for the rest of the Atlantic mariners the storm rocketed off to the north through the Baffin Bay.

During the next week to ten days, a huge High settled in over Europe. At one point its central pressure was 1047 mb and its circulation extended northward to Scandinavia and westward out into the Atlantic.

A couple of mid month storms created some havoc for shipping. The first actually formed east of Japan on the 8th. It moved across the Great Lakes on the 14th, where a few locations reported winds in the 30- to 40-kn range. Stannard Rock, MI recorded gales from about 1200 on the 14th to 0200 on the 15th. Once out into the Gulf of St Lawrence, the Low began to deepen significantly. On the 15th, a 976-mb center reformed over Newfoundland. The following day its central pressure was estimated at 944 mb as it scurried northeastward past Kap Farvel. By then it was getting the attention of shipping. At 0900 on the 16th, the V2QT (51°N, 46°W) ran into a 60-kn southwesterly and a 985-mb pressure while 3 hours later the *Komissar Polukhin* (49°N, 39°W) measured a 52-kn west southwesterly as she battled 33-ft swells. By the 17th, a 954-mb center was found over Iceland and gales had spread into the North and Norwegian Seas. The system remained intense into the 18th but was forced northeastward over the northern Norwegian Sea. Winds over the North Sea remained in the 40- to 50-kn range into the 19th. However, a 944-mb Low was approaching the coast of Norway. This really hadn't been much of a Low until this time. It could be traced back to North Dakota on the 15th. From there it swung southeastward over the southern portion of the Great Lakes and off Cape Cod by the 16th. Even by the 18th, at 1200, its central pressure was estimated at 996 mb. However, by early on the 19th it merged with another developing system and became a double-centered Low positioned south and west of Iceland. By 1200 the North Dakota center was down to 944 mb and 40- to 50-kn winds were common in the North and Norwegian Seas. One report from the FNUB was interesting. At 60°N, 4°W she reported a 958-mb pressure, 73-kn winds and 55-ft seas. While this seems high, a buoy near 58°N, 2°W at 1800 recorded a 65-kn westerly in 30-ft seas and the *Toisa Sentinel* (62°N, 1°E) encountered 41-ft seas. And the FNUB had been reporting faithfully for several hours before and after this event. There is no doubt that this was a powerful system. There was no let up on the 20th as gale and storm force winds with monstrous seas continued. A buoy near 60°N, 2°E, at 0000 on the 20th, measured 57-kn westerlies and 49-ft seas, while the GBXW ran into 70-kn winds in 25-ft seas. The buoy, near 60°N, 2°E, reported a 59-ft sea at 0600 on the 20th. Weather finally eased on the 21st.

The year ended with a bang over Scotland and the North Sea.

Casualties– On the 15th, the *Salem Express*, carrying about 650 people, hit a coral reef during a Red Sea storm and sank off Safaga, some 300 mi southeast of Cairo. It is believed that about 400 people died in this tragedy. The passengers were mainly Egyptians. Apparently the 25-yr old ship had veered off course in an effort to avoid heavy weather.

The Middle East was a weather battleground this month. From the 6th through the 8th, in what was called the fiercest storm in 50 years, 5 people died in Israel and 20 in Jordan as torrential rains triggered flooding. On the 6th, the *M.J.K. III* encountered bad weather near Rhodes and lost six of her eight containers. Also, several vessels in the Cyprus port of Limassol were damaged when wind reached force 9. Four fishing vessels sank in the resort of Paphos, 50 fishing vessels sank in Anatjla harbor and and 20 craft went down off Istanbul. The *Eptanisos* grounded off Mykonos Is on the 8th in strong winds and rough seas, and the MV *Ghiwa* sank off southern Turkey that same day. Conditions were so bad that the Dardanelles St was closed to all but heavy tonnage vessels.

Hogmanay Storm

The following excellent report appeared in *Volume 3 No. 1 of the Ocean Monitor,* a quarterly produced by the **Worldwide Oceanroutes Group**.

Preparations for the weather party began in mid-Atlantic on the 31st of December 1991. The first signs that there was something unusual happening were from a weather ship stationed at around 57.3°N, 20.0°W. Someone had taken the cork out of the champagne bottle and on the hourly observations, pressure had fallen around 6 mb in an hour. This gave the first indication that a severe storm was on the way, but nothing that hadn't been seen before. However, this depression was determined to make its mark in the history books, setting its sights first on the first party goers on the mainland of Northern Scotland, but saving its real demonstration of nature's forces for those in Shetland and for the workers on the platforms in the northern North Sea.

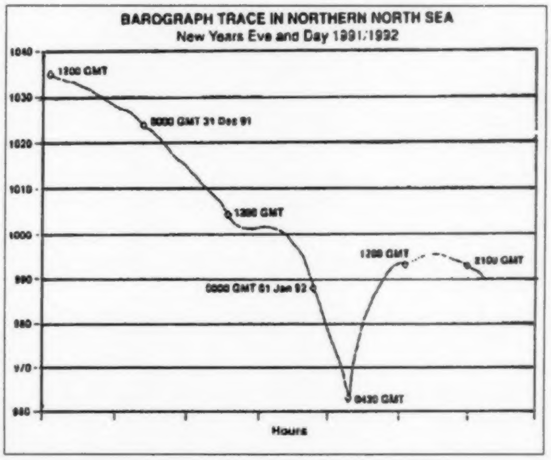
The storm brought much masonry tumbling to the ground at around midnight on the Scottish mainland with winds gusting up to around 100 mph at that time. However, the storm was still gathering strength and as it passed just north of Shetland, it was to wreak havoc in the islands with buildings damaged and caravan sites literally blown away leaving some areas looking like a war zone. Winds on the islands were measured at hourly means of 63 kn with gusts reaching 98 kn, the highest on record. A lighthouse to the north of the islands (Muckle Flugga) was reported to have registered a gust of 150 kn.

Now with its goal in sight, the northern platforms were in for a blow that wouldn't be forgotten quickly. The barograph and anemometer traces below, show just how severe the storm was (both traces reconstructed for the sake of clarity). Pressure at one northern North Sea platform fell almost 7 mb in 40 minutes and then rose 7 mb in the space of 20 minutes at around 0430 UTC as the low passed approximately 120 mi to the north of the platform. The estimated central pressure of the low at the same time was around 947 mb. The barograph and anemometer traces look more akin to a hurricane passing.

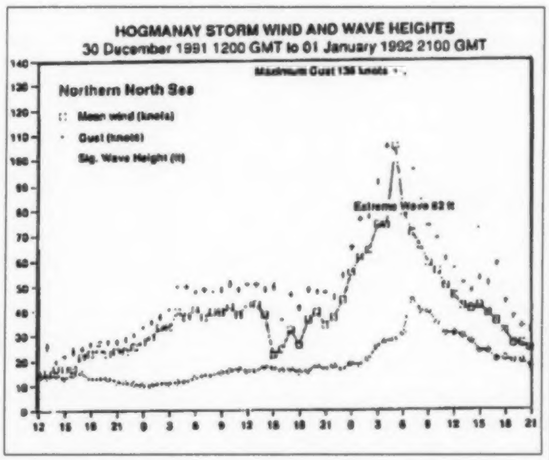
The mean wind on the platform exceeded hurricane force (64 kn) for around 7 hours. For 1 hour, mean windspeeds were up to 106 kn. A gust of 136 kn was recorded at the peak of the storm as it was passing to the north of the platform and the barograph just kicked up. This exceeded by a good measure any winds that had been recorded in this area during the last 20 years.

Significant wave heights of 14.1 m (46 ft) were recorded and the maximum wave height was 25 m (85 ft). (In comparison, the highest wave measured anywhere in the world by reliable equipment, as quoted by the World Meteorological Organization is 33 m (108 ft) in the North Pacific in 1933.)

The diary from the platform, which Oceanroutes' meteorologists man 24 hr a day, makes interesting reading with all the nearby rigs reporting similar wind values and confirming the severity of the storm.



Barograph trace from Dec 31, 1991 to Jan 1, 1992



Wind and wave traces from Dec 30, 1991 to Jan 1, 1992

All times unless noted are UTC (universal time) and all miles are nautical. For additional detail, tropical cyclones will be covered in the annual reports from the tropical cyclone centers around the world. The weather summaries are based upon the track charts and Northern Hemisphere Surface Charts as well as ship reports, and attempt to highlight the most significant ocean features each month. The track charts are provided by NOAA's National Meteorological Center. If an extra-tropical storm is particularly bad for shipping, we may designate it as the Monster of the Month. The Gale Tables provided by the National Climatic Data Center at Asheville, NC, have been expanded to include U.S. ships reporting winds of 34 knots or more.

North Pacific Weather October, November and December 1991

October— The North Pacific mean pressure chart looked more characteristic of summer than autumn. The Pacific subtropical high with a double center was the dominant feature, while the Aleutian Low was elusive. The split high resulted in positive pressure anomalies over the northeast North Pacific and, aided by an extension of the Siberian High, over the Sea of Okhotsk. In the central Pacific, pressures were actually below normal because of the split, and it looked like the Aleutian Low fell into this crevice. The summertime nature of the Pacific was further enhanced by a number of tropical cyclones in both the eastern and western tropics.

The month opened with Tropical Storm Orchid coming to life in the western Pacific and Hurricane Kevin in the east. A 1030-mb High dominated the northern waters flanked by a large number of weak highs and lows. Pat and Linda joined the action in the tropics, while no real storms developed in the north during the first week of the month. Both Orchid and Pat became typhoons by the 9th, while Tropical Storm Marti joined the parade in the east.

Finally, on the 11th, an extratropical system began to intensify into a real storm. By 0000 on the 12th, a 964-mb center was located near 40°N, 165°W. Several vessels reported 40- to 45-kn winds including the CG62965, ***World Wing II*** and the ***Neptune Agate***. The ***Star Livorno*** hit 52-kn westerlies in 30-ft seas near 34°N, 167°W. Meanwhile, the ***Astro Jyojin*** (34°N, 138°E) was encountering similar conditions in Tropical Storm Orchid. The extratropical storm moved northeastward but weakened as it approached the Gulf of Alaska on the 14th. It was still potent enough to be generating gales, however.

By this time, Orchid and Pat had turned extratropical and their two centers were the heart of a system that was generating gales between Japan and the Dateline. At 0900 on the 14th, the ***Sohgen Maru*** (44°N, 155°E) ran into 50-kn westerlies in 20-ft swells with a 987-mb pressure. The double-centered system moved along the Kurils and turned northeastward on the 15th. Winds of 40 kn in 15-ft seas were common over the northern shipping lanes of the western North Pacific even as the system began to weaken. It reached the Alaskan Peninsula as a 993-mb Low on the 17th. Except for a frontal system, squeezed by a 1040-mb High, along the 165th parallel (east) between 35°N and 50°N, things were relatively quiet. This gradient was enough to generate gales west of the Dateline to about 150°E for a couple of days. This lasted until Super Typhoon Ruth showed up on the 22d. The storm achieved super typhoon status (>130 kn) by the 24th. Most ships kept their distance. The ***Northwest Swift***, for example, ran into 44-kn northwesterlies in 17-ft swells, some 400 mi to the west of Ruth's center, early on the 25th.

While Ruth weakened over the next few days, an extratropical storm came to life near 50°N, 165°E. Before the month was out, its central pressure dipped to 966 mb on the 30th among the Aleutians. The system was intense enough to generate some gales along the northern shipping lanes.

Casualties— Typhoon Orchid devastated Japan on the 12th and 13th. Torrential rains triggered some 249 landslides, flooded hundreds of homes, left one person dead and fourteen injured. Orchid was the ninth typhoon to hit or come close

to the Japanese archipelago this year.

The 105-ft U.S. fishing vessel *Tonquin* reported to the communications station at Kodiak that it was sinking 30 mi northeast of Sitkinak Is and that the 5-man crew was abandoning ship. Seas were 15 ft and winds were 25 kn at the time. An H-3 helicopter from Kodiak located the crewmen in a liferaft, and the USCGC *Ascushnet* maneuvered alongside and recovered the men. The fishing vessel *Topaz* also assisted with the rescue and recovered three men in survival suits. The master of the vessel was not found.

U.S. Coast Guard

The USCGC Yocona tows the F/V Sable Sea in the Shelikof Strait, 90 miles southwest of Kodiak, AK. The 67-ft fishing vessel became disabled in 90-kn winds and 20-ft seas during a late November storm. Both vessels reached port 3 days later.

November— To conclude that this was a wild month in the western North Pacific would be an understatement. Tropical activity was reminiscent of September, while extratropical storms made it seem like January. Part of this is reflected in the mean pressure chart for November. The Aleutian Low dominated the ocean north of 40°N, and an area of -6 mb anomalies stretched from the Gulf of Alaska southwestward to 40°N, 170°W. The subtropical high was squeezed from mainly east of 150°W to the California coast, creating an area of +4 mb anomalies in this region. This was a reflection of a large amount of anticyclonic activity between 30° and 35°N and 130° and 140°W.

During the first week, several low pressure centers combined to form a huge low pressure system centered south of the Alaskan Peninsula, covering most of the northern North Pacific. In fact a ship near 50°N, 166°E, some 1300 mi west of the main center, ran into 40-kn northwesterlies at 1200 on the 4th. Early on the 5th, a single 968-mb center was found near 53°N, 157°W. The *Shiraoi Maru* (45°N, 158°E) ran into a 64-kn south southwesterly in 12-ft swells. Six hours later, she was measuring 54-kn southwesterlies. In general, ships farther from the center were encountering winds in the 40- to 45-kn range and swells up to 17 ft. To the southwest, Seth had reached super typhoon strength while Thelma was a tropical storm, off Samar, in the Philippines. By the 9th, Tropical Storm Verne was interacting with Typhoon Seth. The JXRF (17°N, 126°E) about 30 mi to the west of Seth's center, measured a 67-kn northwesterly in 23-ft swells at 1200.

A powerful 968-mb Low moved in on the Alexander Archipelago, near Juneau, on the 11th. At 1200, the ***Prince of Tokyo 2*** (50°N, 138°W) encountered 47-kn west southwesterlies in 18-ft seas and measured a 983-mb pressure. The ***Sea-Land Tacoma*** measured 41-kn south southwesterlies in 13-ft seas farther east. At 1800, the ***Hanjin Oakland*** (47°N, 137°W) checked in with 47-kn winds in 17-ft swells. Conditions began to improve on the 12th as the system moved ashore.

However, on the 14th a 964-mb Low showed up near 55°N

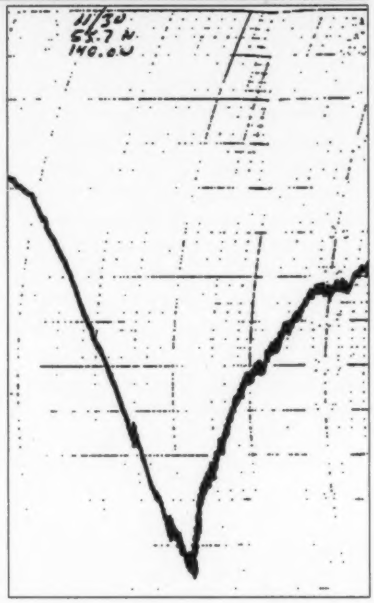
and the Dateline. It was nearly stationary and caused some real problems along the northern shipping lanes. At 1800 on the 13th, the ***Shiraoi Maru*** (52°N, 134°W) ran into 58-kn west northwesterlies in 13-ft swells, while some hours later the ***California Triton*** hit 60-kn winds in 25-ft swells. Storm force winds continued into the 14th and were encountered by vessels such as the ***California Mercury, Alligator Pride*** and the ***California Triton***. The original system was reinforced by another low center to the south on the 15th and very rough conditions continued to plague the northern lanes into the 16th. At 0000 on the 16th, the ***Professor Kizevetter*** (49°N, 162°E) measured a 68-kn northerly, but most reports were in the 40- to 50-kn range with seas of 15 to 20 ft. The system broke into separate smaller storms on the 17th. One was located as an intense center over Vancouver Is early on the 17th. Several ships reported pressures below 980 mb and the ***Keystone Canyon*** (54°N, 137°W) measured a 969-mb pressure. Winds were reported in the 40- to 45-kn range.

The next big system came along on the 18th when a 968-mb Low was spotted near 52°N, 152°W. The ***Continental Wing*** (48°N, 155°W) measured 46-kn winds and a 985-mb pressure in 17-ft swells at 0600. Her winds increased to 48 kn while pressure dropped to 982 mb 6 hours later. These excellent reports were substantiated by BONG at 1800. The ELJS6 continued reporting into the 19th as winds remained in the 40- to 45-kn range and swells increased to 20 ft. The ***Khudozhnik Kraynev*** (52°N, 145°W) at 0000 on the 19th measured a 965-mb pressure in 45-kn winds, and at 1200 the ***Admiralty Bay***, in 21-ft seas and 46-kn south southeasterlies, read a barometer of 972 mb near 55°N, 140°W, while the ***Prince of Ocean*** encountered a 55-kn north northwesterly near 54°N, 158°W. By this time, the 964-mb center had crossed the 55th parallel near 145°W. It began to weaken the following day.

On the 22d, a 972-mb Low off the Kamchatka Peninsula and a 980-mb Low near 45°N, 155°W were dictating the North Pacific weather, resulting in gale and storm force winds over a large area. For example, at 0000 on the 22d the WRYW(43°N, 142°W) hit 53-kn south southeasterlies in 25-ft swells, while the ***MYS Kurilskiy*** (50°N, 156°E) ran into 50-kn northerlies in 17-ft seas. Conditions remained rough into the 23d.

Toward the end of the month, a large 1040-mb High became entrenched over the eastern North Pacific and an extratropical storm moved eastward from Japan, along the 40th parallel, generating gales. In the tropics Yuri was reaching typhoon strength and recurving northeastward across the 20th parallel. The Japan Low was particularly active on the 29th, when several vessels measured 55-kn winds in 20-ft swells in the vicinity of 40°N, 155°E. The ***Vera Acorde*** and the ***Suruga Maru*** were among these vessels. This general area, between the Japan Low and Yuri, continued to be a hot spot into the 30th. The ***Nyk Sunrise*** (39°N, 159°E) hit 66-kn north northwesterlies at 0000 on the 30th and the ***Vera Acorde*** reported 23-ft seas.

Casualties— Based on preliminary information it is easy to conclude that Tropical Storm Thelma was devastating. At last count, the death toll exceeded 5,000 people, with another 2,000 missing, in the Philippines. The major cause of this disaster was flash floods triggered by torrential rains. In Leyte



*The **Sea-Land Anchorage** had two rough voyages from Tacoma to Anchorage at the end of November and the beginning of December. She provided two barographs as proof. This one (above) shows a low pressure of 976 mb right at midnight on the 30th of November, while the one to the right shows a wicked drop to 967 mb at about 1800 on the 8th of December.*

these floods were assisted by deforestation caused by illegal logging. Decomposing bodies littered the streets in Ormoc City on the west coast of Leyte, where hundreds of bodies were washed ashore. They were swept out into Ormoc Bay when a nearby dam burst, while other were buried alive under landslides.

On the 9th, the U.S. Coast Guard rescued six people from the grounded 128-ft crabber ***Sunset Bay*** on the north shore of Unimak Is in the Aleutians. A helicopter from Kodiak and the USCGC ***Storis*** took part in the rescue. Because of the strong winds and high seas, the cutter launched two smaller boats, but both became disabled and floated ashore. The helicopter later picked up all six people from

the crabber as well as the eight Coast Guardsmen aboard the smaller boats. At Dutch Harbor, one crewman and one Coast Guardsman were treated for mild hypothermia.

December–While the Aleutian Low usually blankets the Bering Sea, and a good portion of the northern North Pacific on the December mean pressure charts, it was even more intense than normal in 1991. In addition, the Pacific subtropical high was more extensive than normal. Anomalies from these two situations were down to -14 mb in the Gulf of Alaska and up to +6 mb near 35°N, 170°W.

The month opened with Typhoons Yuri and Zelda roaming the western North Pacific and a large 975-mb Low near 45°N, 170°W, generating gales around its center. Yuri was on its way to becoming extratropical as a 968-mb Low. It maintained this intensity over the next several days as it moved northeastward toward the Gulf of Alaska, where it combined with the mid latitude low into a single 962-mb center. This Low dominated weather over the northeastern North Pacific on the 5th and 6th. At 0000 on the 6th, the ***Khudozhnik Kraynev*** (53°N, 154°W) ran into a 52-kn westerly in 18-ft seas and the ***Eastern Venture*** (55°N, 151°W) at 0600 reported 44-kn west northwesterlies in 25-ft swells and a 976-mb pressure. These were typical of the reports for the storm, which moved ashore late on the 6th.

This was followed by a system that could have easily been overlooked in the safety of an office. In fact, if it weren't for the ***Sea-Land Anchorage***, it would have been. The system approached and left the Gulf of Alaska as a 970-mb Low, nothing unusual for this time of the year. However, for a few hours late on the 8th and early on the 9th it deepened into a wicked storm, with pressure dropping to an estimated 956 mb. The ***Sea-Land Anchorage*** had just finished with a potent storm on her previous voyage, when she ran into this one. Her barograph trace (above) tells only part of the story. The Second Officer mentions: "Our bridge was 90 ft above the water. The Captain [Capt Dickerson] and I were on the bridge at the time and the breaking crests were above us ..." at a time when the ship was horizontal. The weather log for the vessel indicated that the vessel was struck by five successive very steep 90-ft swells and the ship rolled in excess of 45° to starboard and 40° to port each time. At 1600, skies were overcast with heavy rain, hurricane force winds and mountainous seas. Hurricane force winds were observed from 1600 to 2000 on the 8th. The storm moved inland later on the 9th.

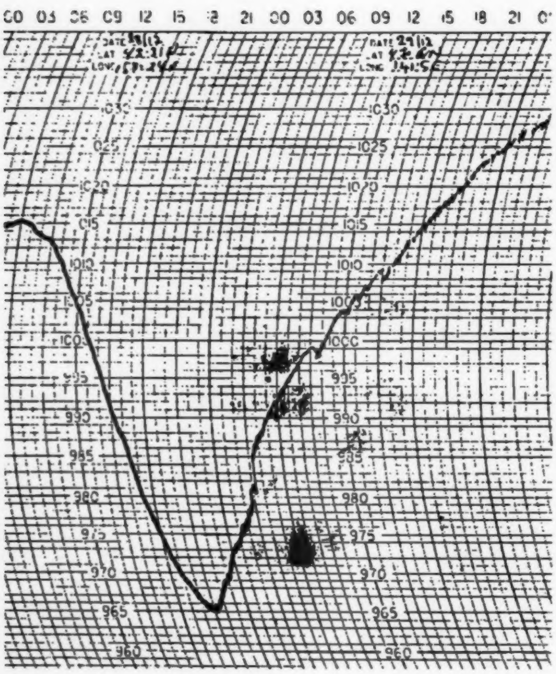
An innocuous looking 977-mb Low moving northeastward off the Kurils on the 12th suddenly and briefly exploded on the 13th as it moved through the Aleutains. A number of vessels were caught by 40- to 50-kn winds and seas of 10 to 20 ft, which swept over the northern shipping lanes. Typical, was the report from the ***Michigan Highway*** (53°N, 180) at 0000 on the 14th, which measure 49-kn westerlies in 20-ft seas. The storm continued rapidly northeastward and weakened as it moved across Nunivak Is and into western Alaska.

On the 17th, a Low began to intensify as it approached the Dateline near 40°N. From 988 mb at 1200, the central pressure dipped to 965 mb some 24 hr later. While it was south of the northernmost shipping lanes, the DEGB (35°N, 171°W) ran into a 68-kn wind in heavy rain showers. As the storm swung northward, it retained its strength, generating gales and 20-ft swells. The DEGB continued to send in a series of excellent reports. On the 19th, the central pressure rose to 973 mb but the following day it fell back to 963 mb as the center headed toward the Gulf of Alaska. At 1800 on the 19th, the ***Young Scope*** (50°N, 144°W) measured a 48-kn east southeasterly with a 985-mb pressure in 15-ft swells, while the ***Prince of Ocean*** (50°N, 150°W) hit 47-kn winds in 20-ft swells with a 982-mb pressure. The ***Century Highway No 5*** came in with several good reports, which indicated winds were blowing in the 50-kn range near 47°N, 132°W, along the storm's associated cold front. At 1800 on the 20th, the ***Exxon Benicia*** (58°N, 142°W) measured a 966-mb pressure in 40-kn easterlies as the storm headed toward the Alaskan mainland.

While this Gulf of Alaska storm was still generating gales, another more potent system was right behind it. At 1200 on the 20th, a 952-mb storm was centered near 52°N, 175°E. The DEGB got a piece of this storm as well and came in with a measured 54-kn southwesterly in 20-ft swells near 34°N, 179°E at 0000 on the 21st. In general, winds were blowing at 40 to 45 kn and swells were ranging from 15 to 20 ft during the 21st and 22d as the storm moved along the Aleutians and Alaskan Peninsula. Typical of the reports was that of the DLBD (44°N, 141°W) at 0000 on the 24th, which measured a 45-kn westerly in 17-ft seas and 20-ft swells.

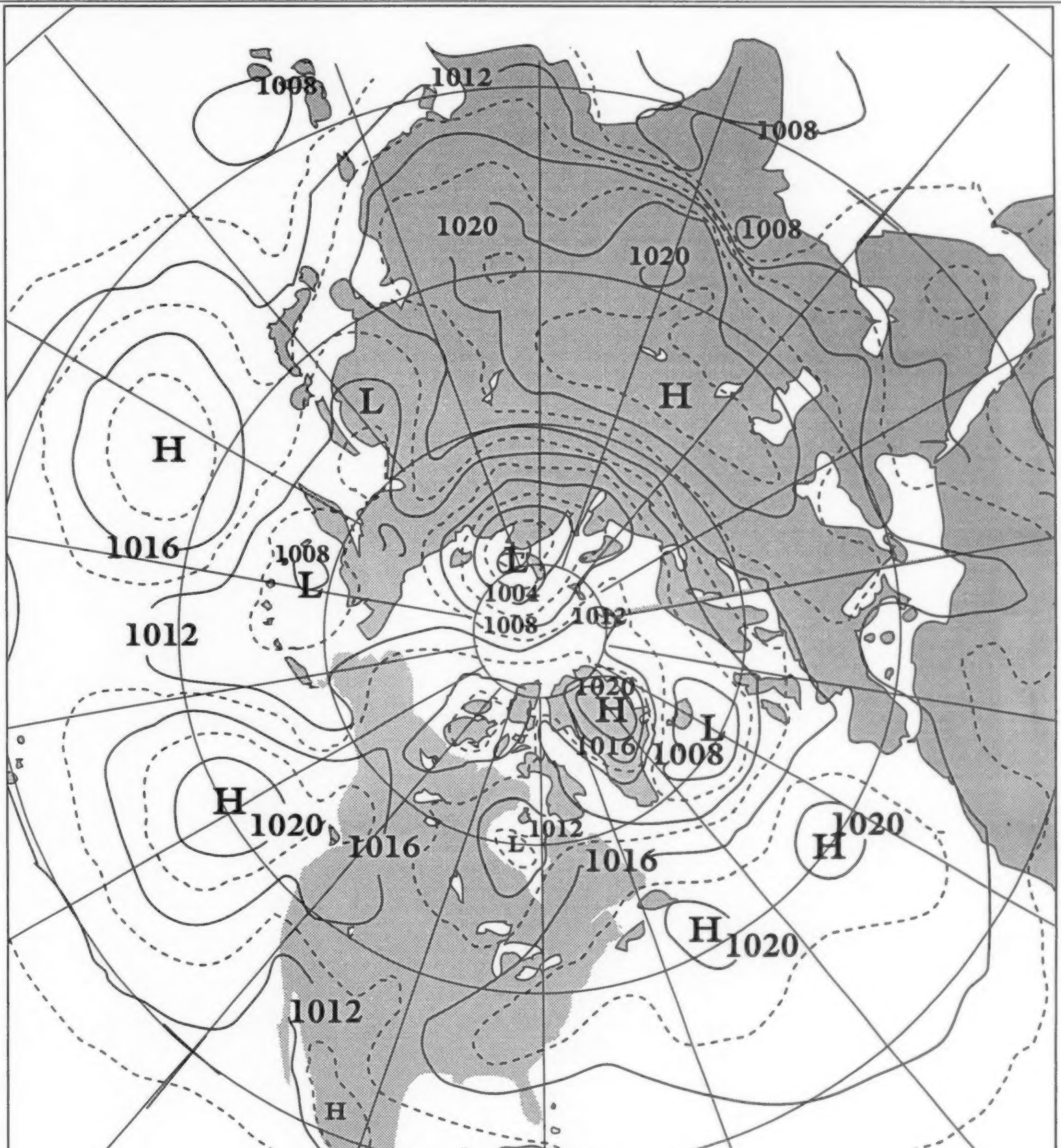
There was one last Aleutian storm that mariners had to contend with in December. This system formed south of Tokyo on the 25th and moved rapidly east northeastward. By the 27th it was a 962-mb storm crossing the 45th parallel near the Dateline. Its active cold front was also causing problems south and southeast of its center. Several reports of 60-kn winds came in from ships around the 35th parallel. While this storm was dominating weather over the eastern North Pacific, an intense Low was developing over the Kuril Is to the west. By 1200 on the 29th, several other centers combined into a 946-mb circulation. By the end of the month it was a huge 957-mb storm centered over the Aleutians and looking like a model for the Aleutian Low. Needless to mention, it did not go unnoticed by Pacific mariners. On the 29th at 0000, the ELZH (47°N, 152°E) encountered a 58-kn wind while some 18 hr later, in the same location, the *Svetlaya* reported a measured 78-kn north northeasterly in 17-ft seas, with a 977-mb pressure. In general, winds over the shipping lanes in the north were 40 to 50 kn while seas ran 15 to 20 ft as the month came to a close.

Casualties—The Hawaiian Is of Kauai suffered some heavy rains on its northeast side on the 13th and 14th. These torrential downpours, up to 15 in. in a 24-hour period, resulted in flash floods that destroyed or heavily damaged about 50 homes and were responsible for one death.



This barograph was taken by the McKinney Maersk while enroute from Oakland to Hong Kong. Her lowest pressure of 965 mb was measured on the 28th at about 2100, while she was sailing west of the Dateline at about 45°N, 150°E. This was related to the storm described above.

October 1991

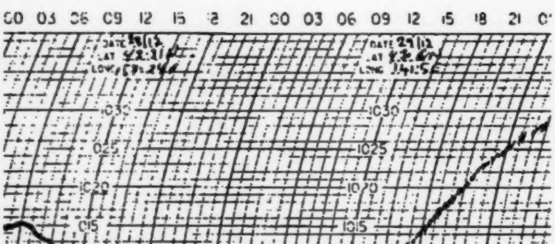


These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin*.

While this Gulf of Alaska storm was still generating gales, another more potent system was right behind it. At 1200 on the 20th, a 952-mb storm was centered near 52°N, 175°E. The DEGB got a piece of this storm as well and came in with a measured 54-kn southwesterly in 20-ft swells near 34°N, 179°E at 0000 on the 21st. In general, winds were blowing at 40 to 45 kn and swells were ranging from 15 to 20 ft during the 21st and 22d as the storm moved along the Aleutians and Alaskan Peninsula. Typical of the reports was that of the DLBD (44°N, 141°W) at 0000 on the 24th, which measured a 45-kn westerly in 17-ft seas and 20-ft swells.

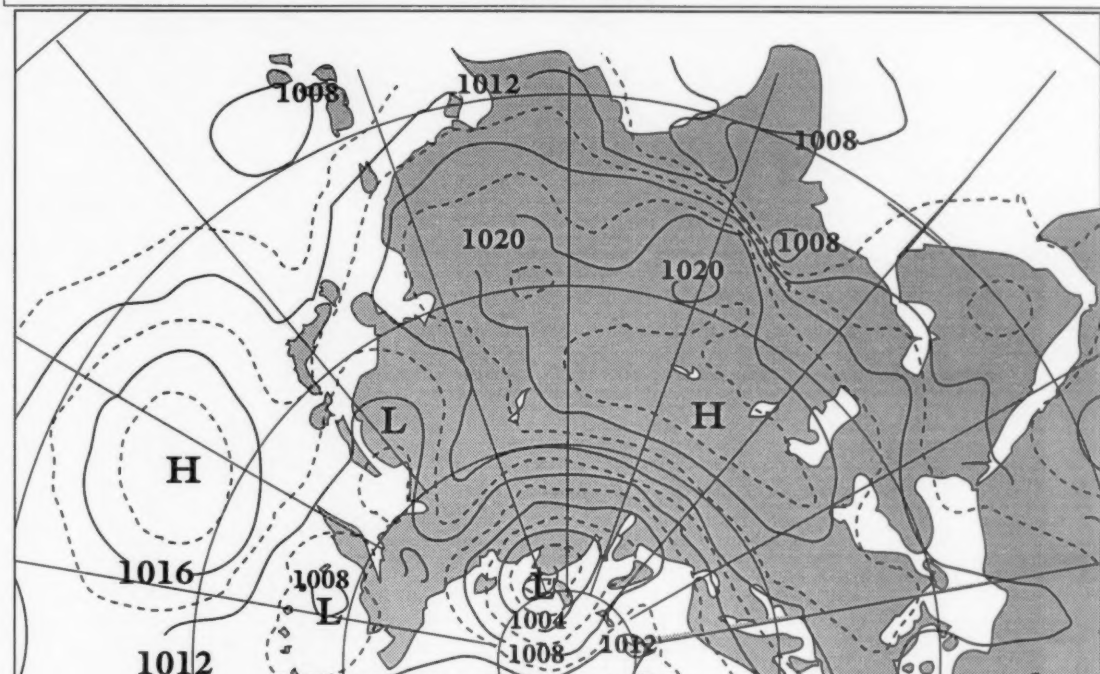
There was one last Aleutian storm that mariners had to contend with in December. This system formed south of Tokyo on the 25th and moved rapidly east northeastward. By the 27th it was a 962-mb storm crossing the 45th parallel near the Dateline. Its active cold front was also causing problems south and southeast of its center. Several reports of 60-kn winds came in from ships around the 35th parallel. While this storm was dominating weather over the eastern North Pacific, an intense Low was developing over the Kuril Is to the west. By 1200 on the 29th, several other centers combined into a 946-mb circulation. By the end of the month it was a huge 957-mb storm centered over the Aleutians and looking like a model for the Aleutian Low. Needless to mention, it did not go unnoticed by Pacific mariners. On the 29th at 0000, the ELZH (47°N, 152°E) encountered a 58-kn wind while some 18 hr later, in the same location, the ***Svetlaya*** reported a measured 78-kn north northeasterly in 17-ft seas, with a 977-mb pressure. In general, winds over the shipping lanes in the north were 40 to 50 kn while seas ran 15 to 20 ft as the month came to a close.

Casualties—The Hawaiian Is of Kauai suffered some heavy rains on its northeast side on the 13th and 14th. These torrential downpours, up to 15 in. in a 24-hour period, resulted in flash floods that destroyed or heavily damaged about 50 homes and were responsible for one death.



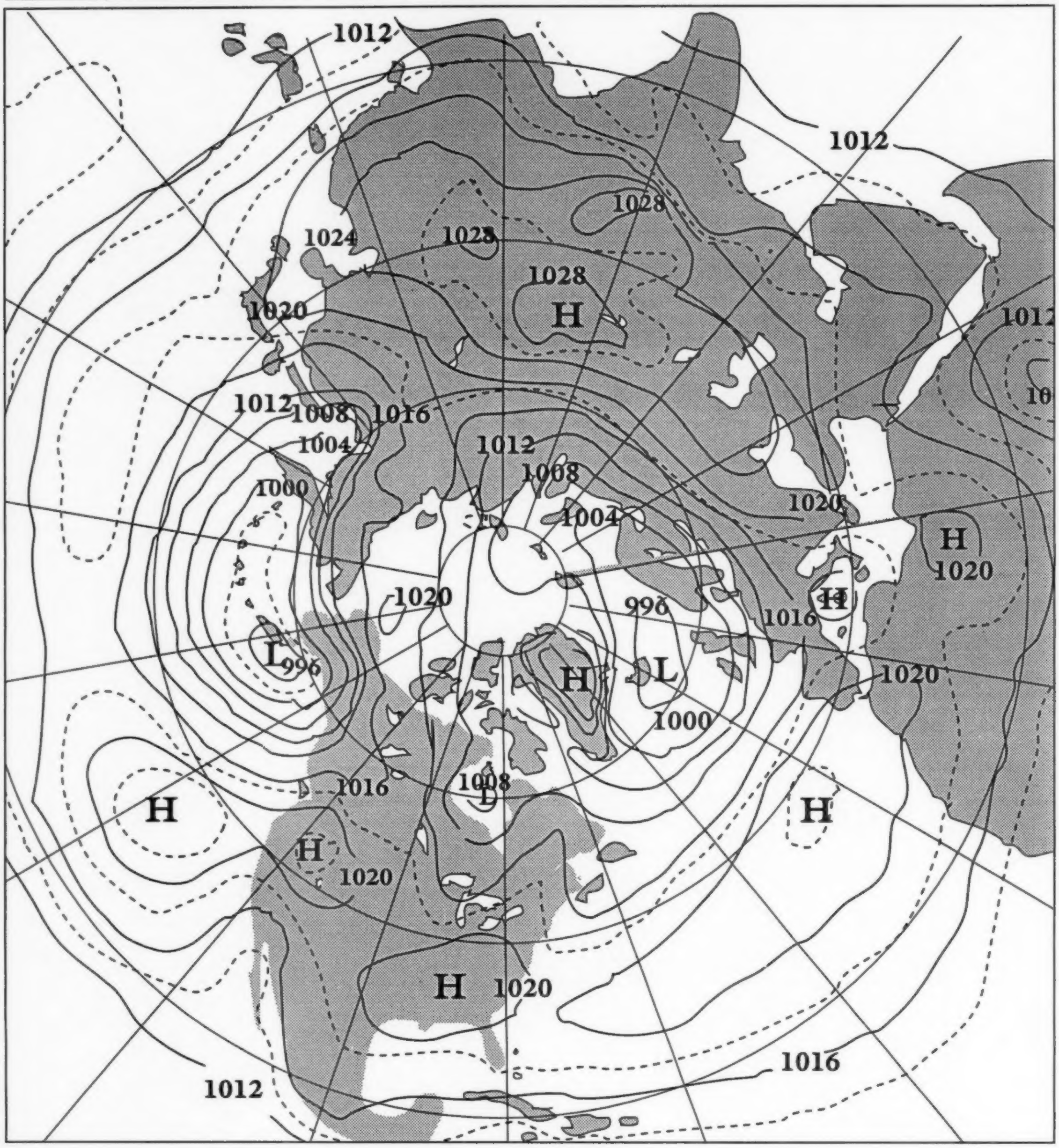
This barograph was taken by the McKinney Maersk while enroute from Oakland to Hong Kong. Her lowest pressure of 965 mb was measured on the 28th at about 2100, while she was sailing west of the Dateline at about 45°N, 150°E. This was related to the storm described above.

October 1991



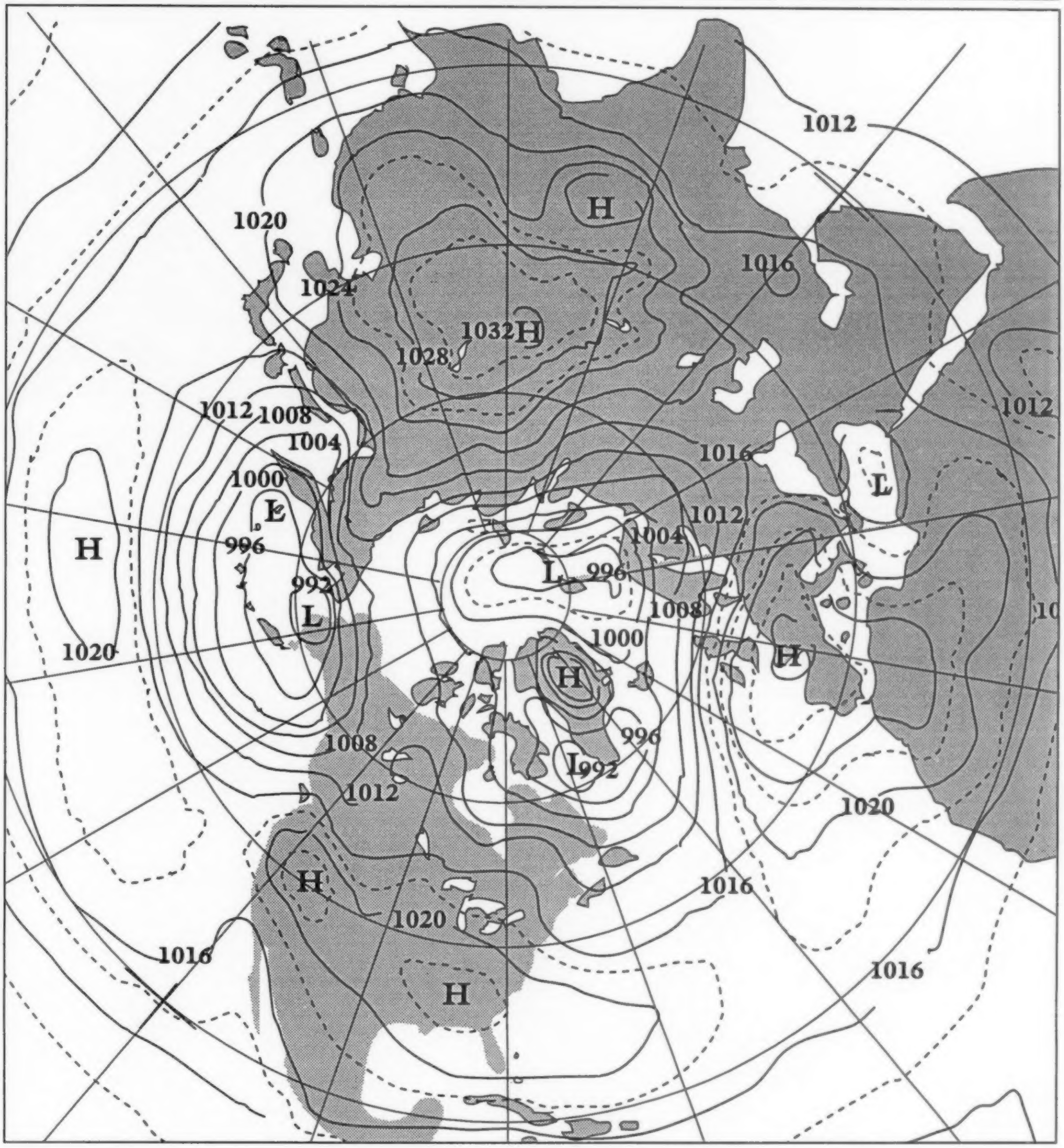
These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin*.

November 1991



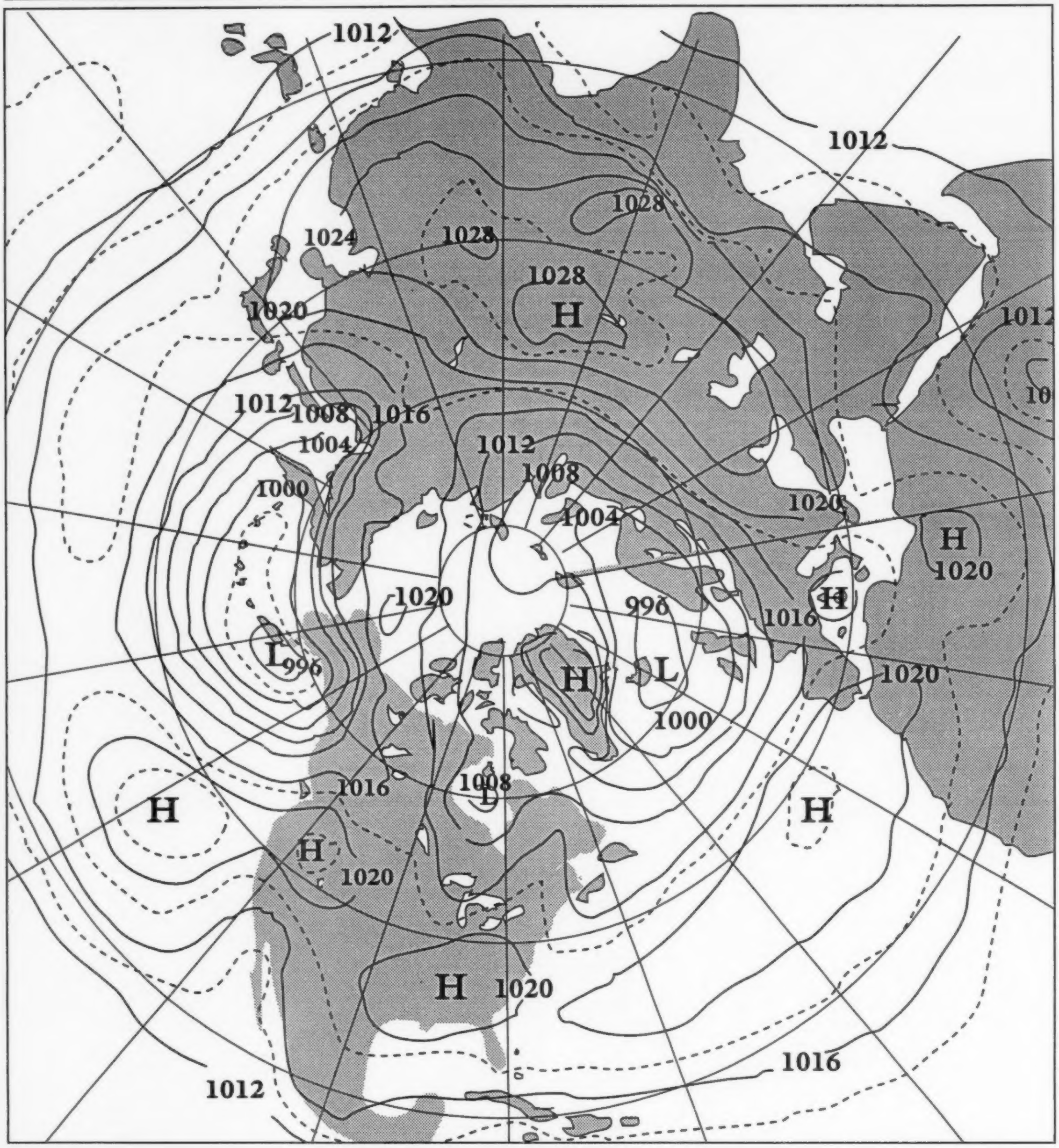
These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin.*

December 1991



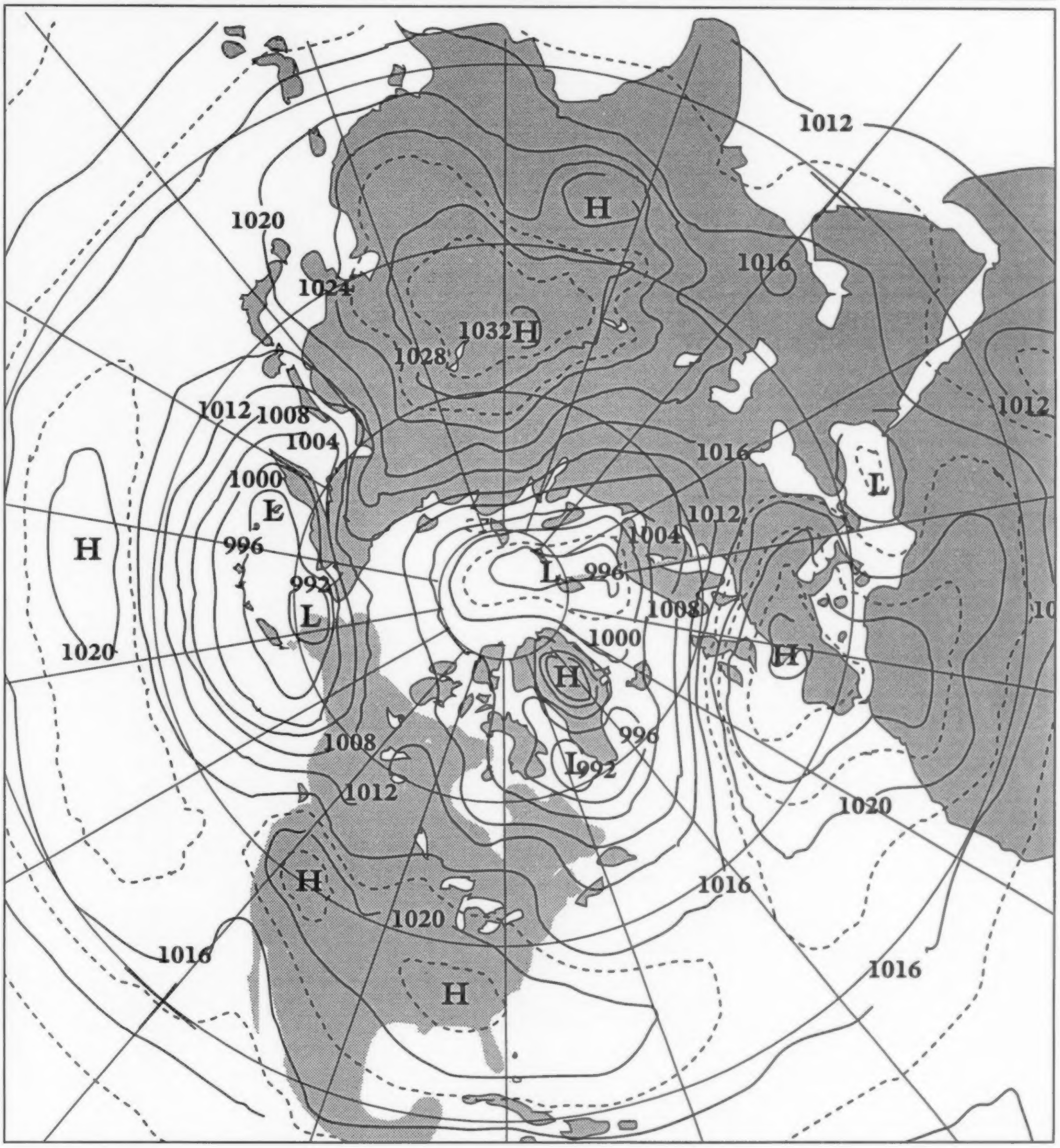
These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin*.

November 1991



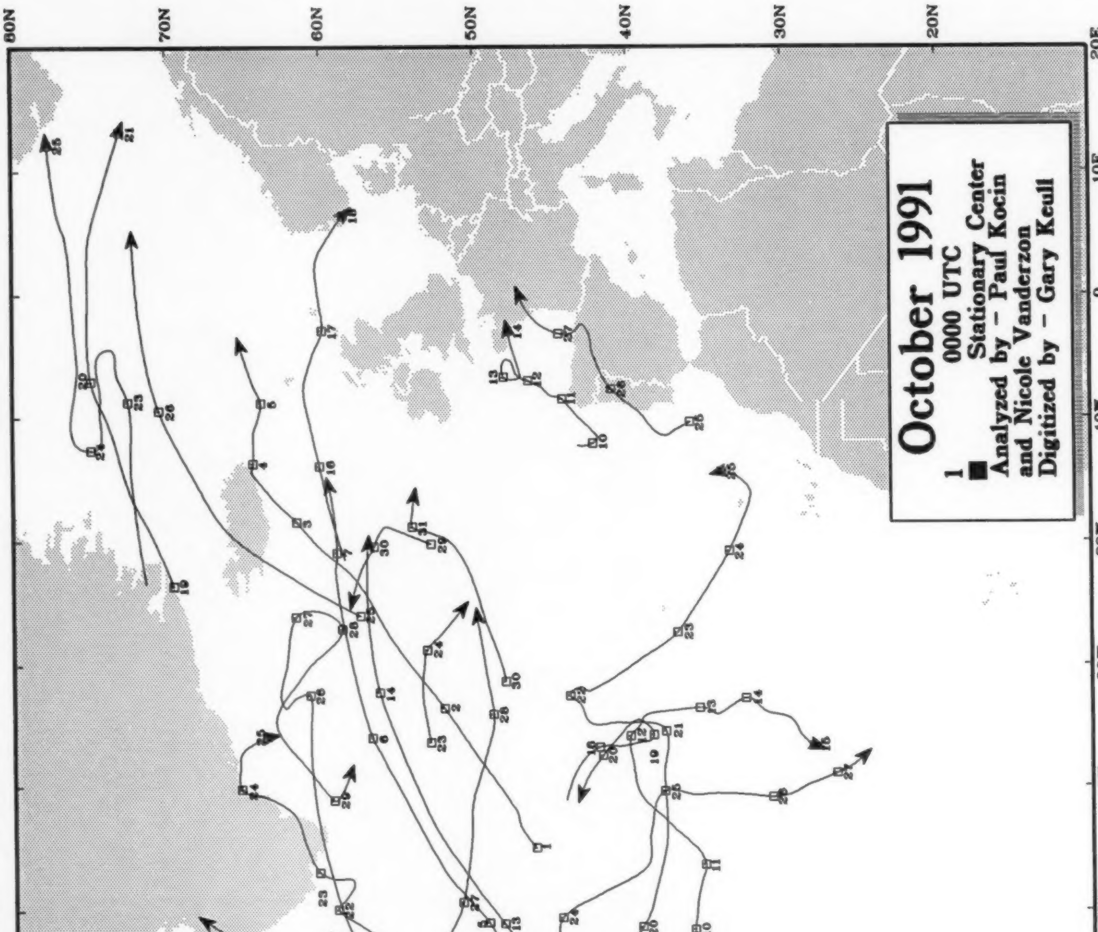
These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin*.

December 1991

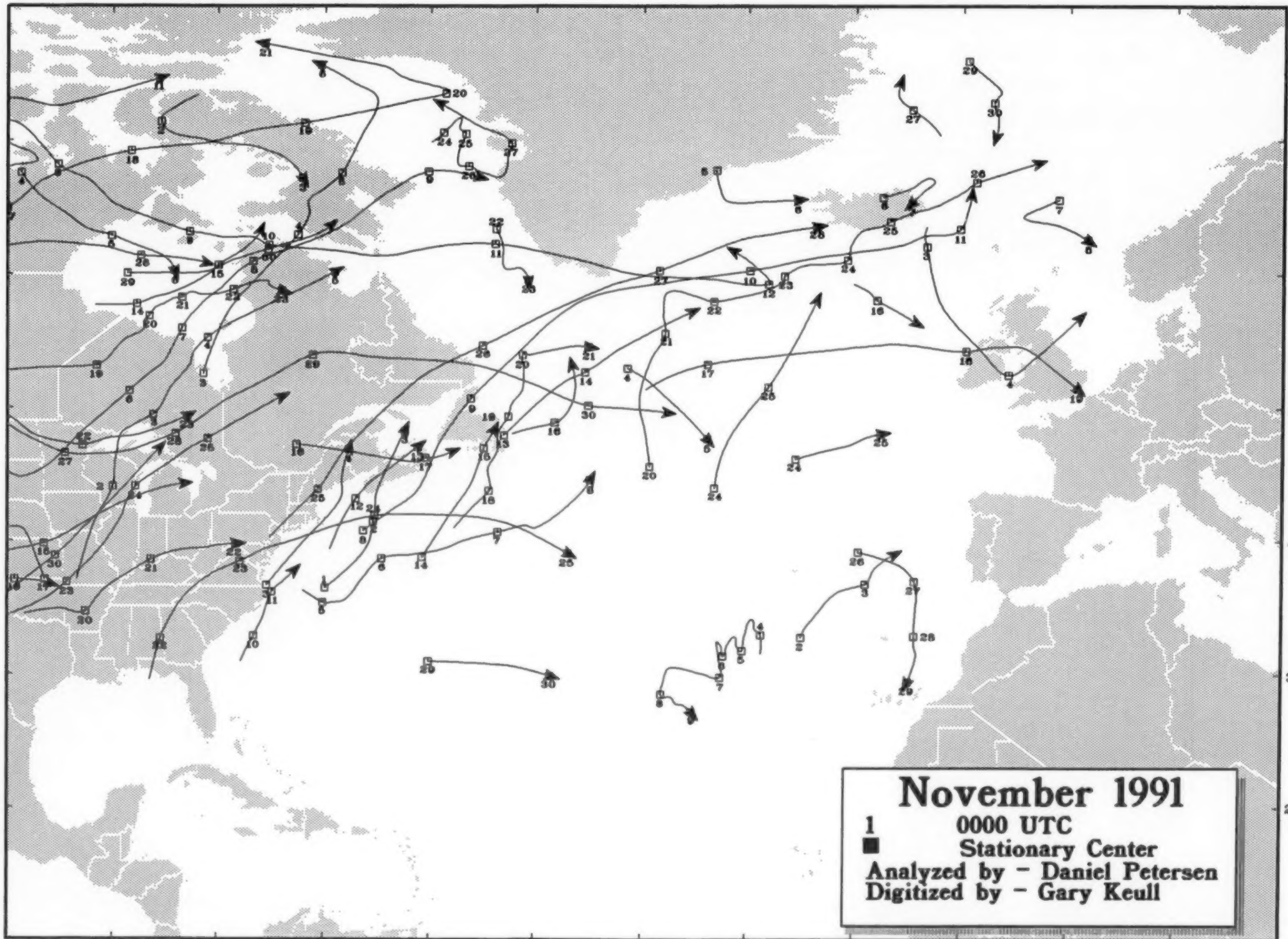


These Charts were Provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the *Climate Diagnostics Bulletin*.

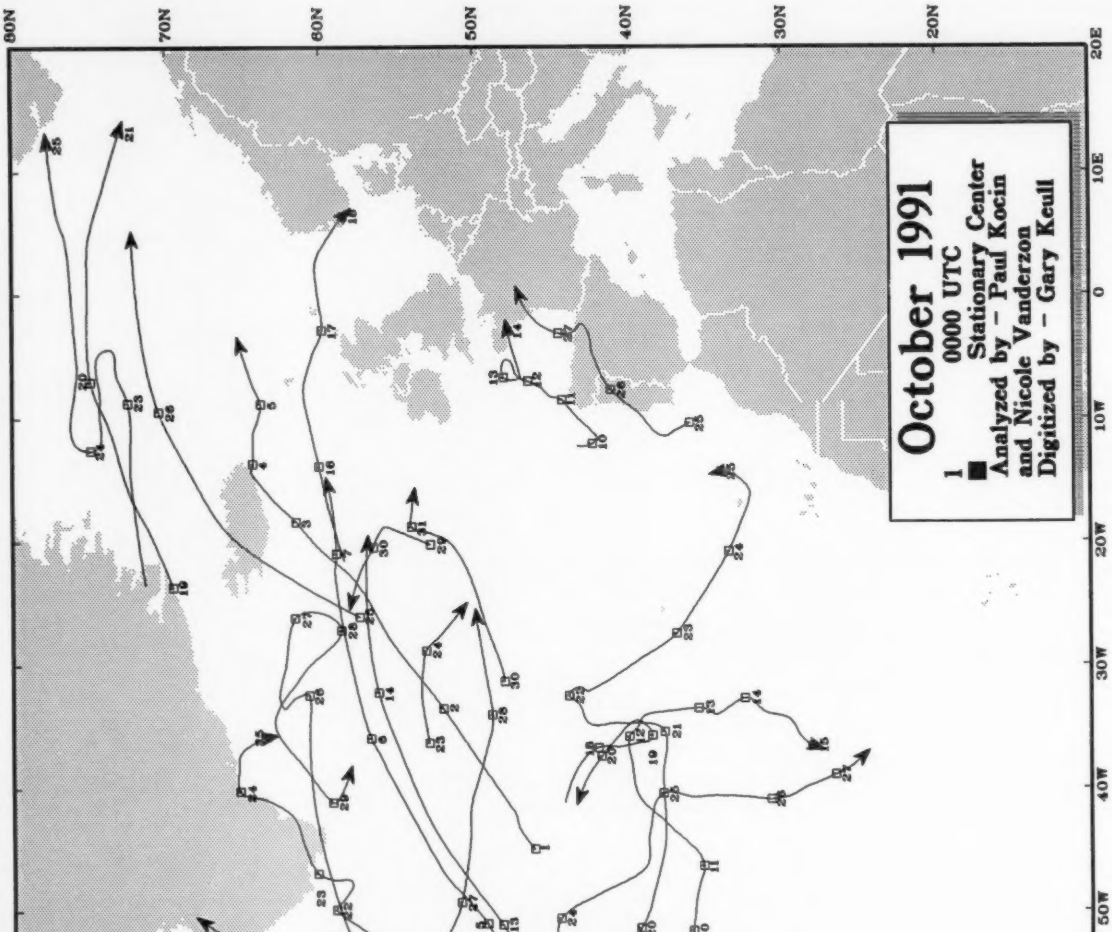
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



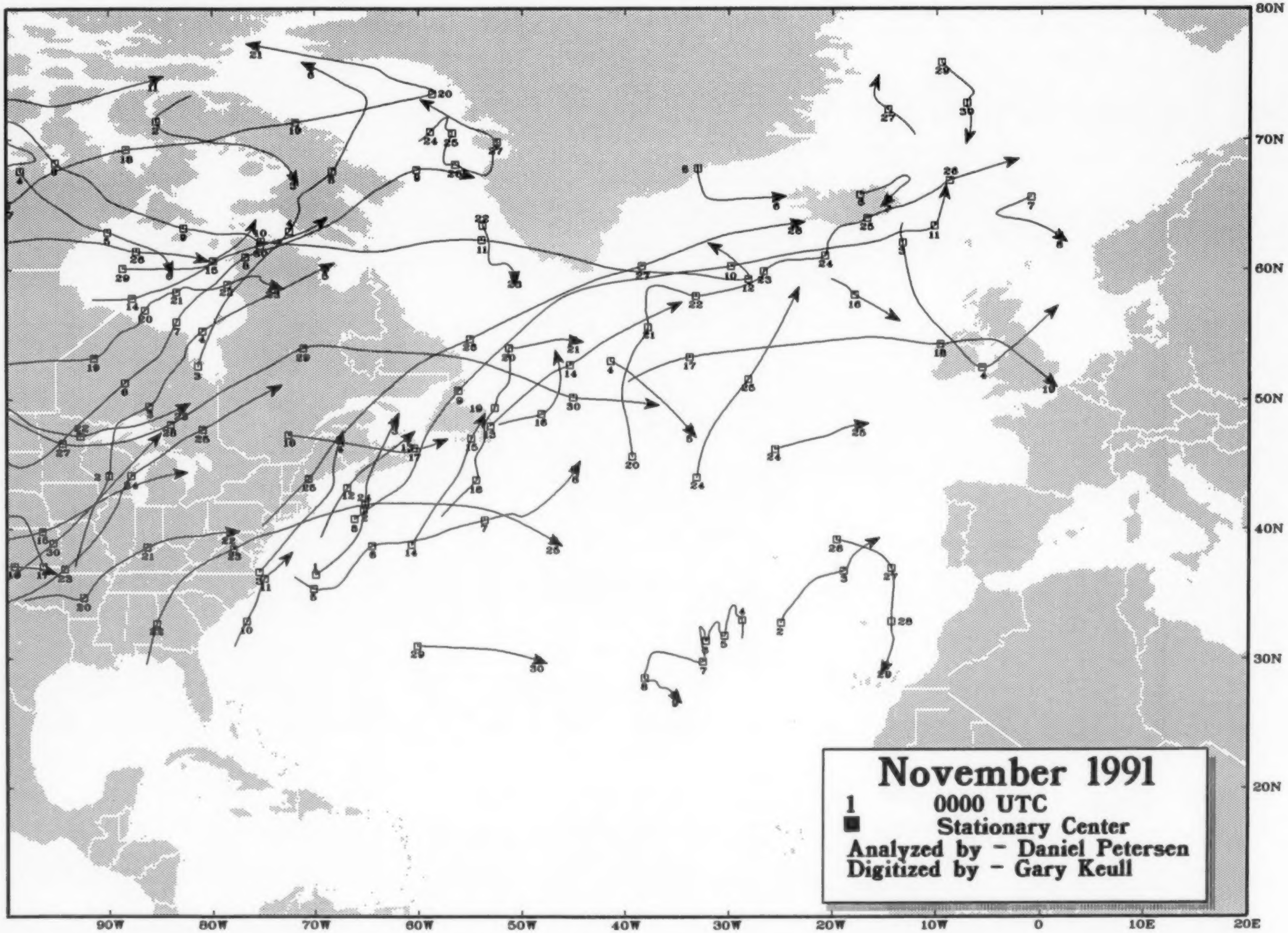
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



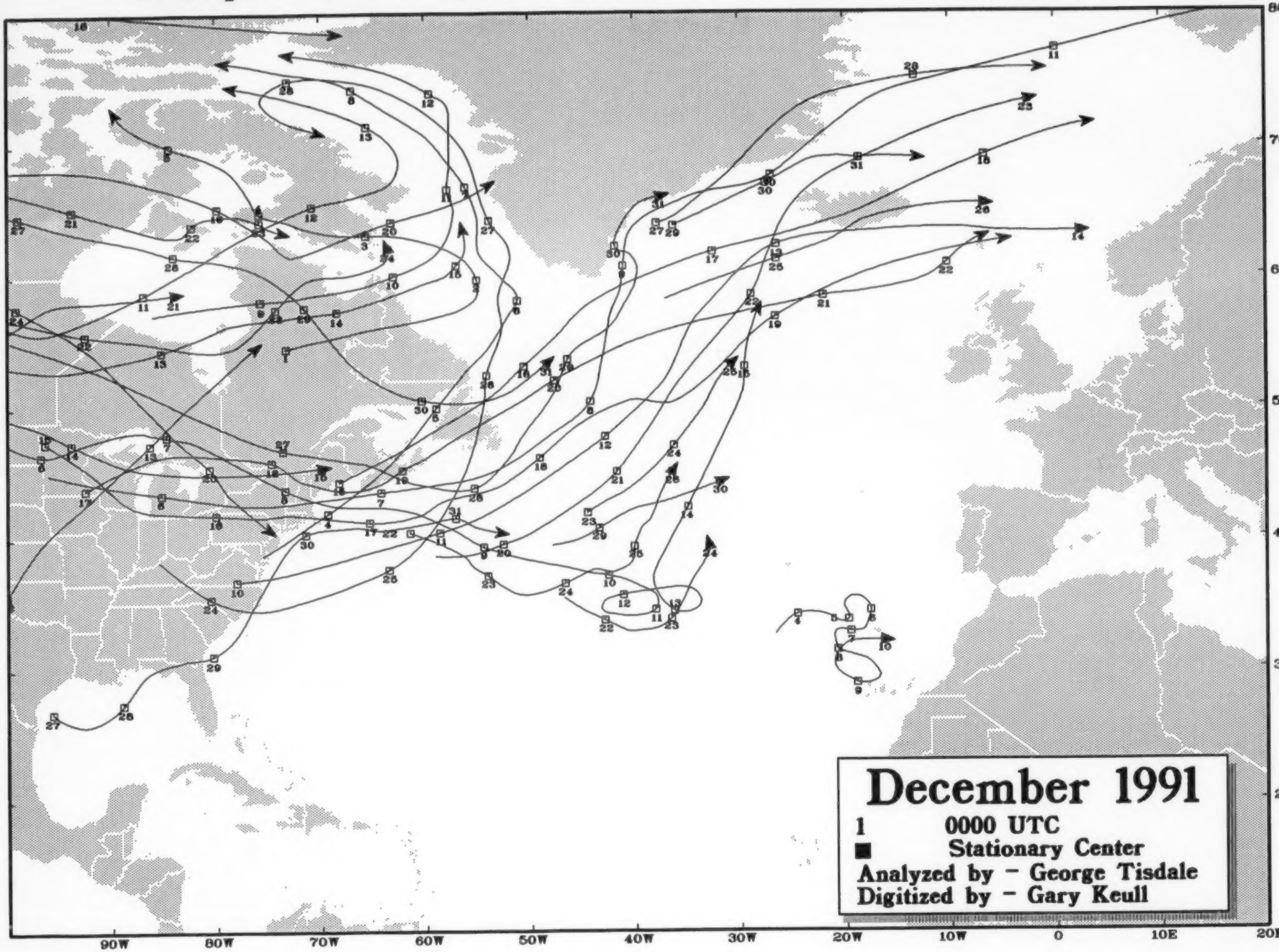
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



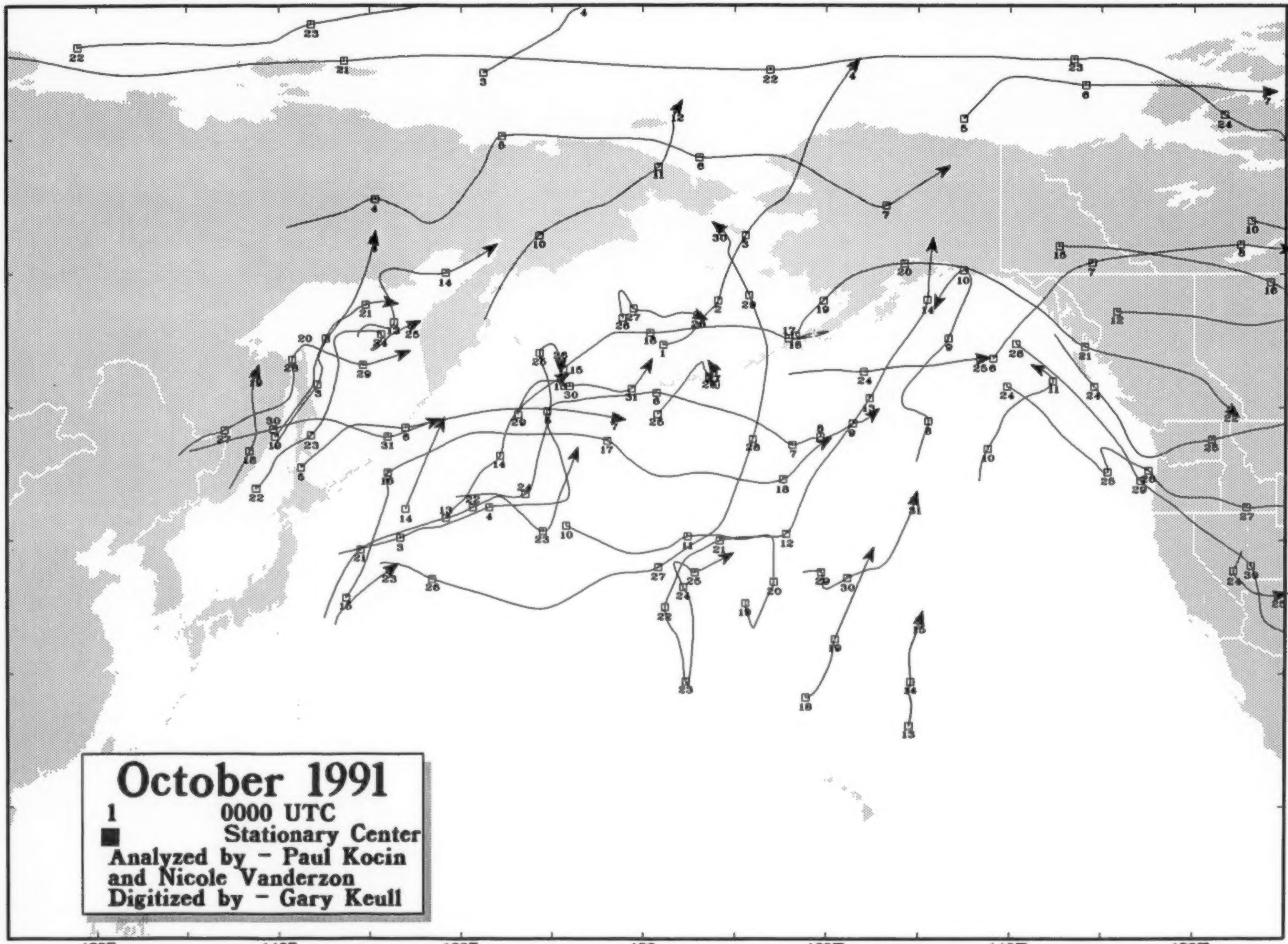
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



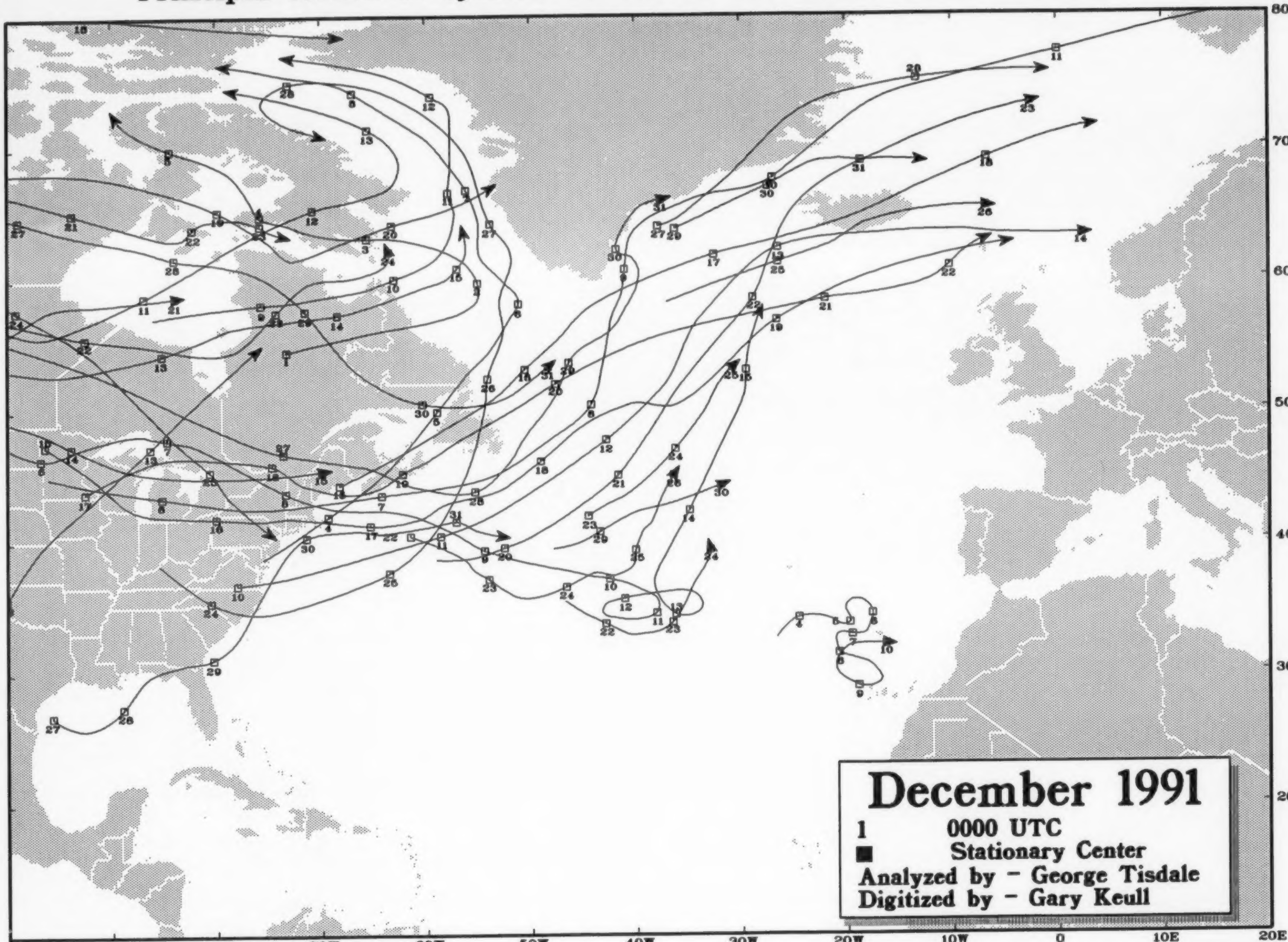
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic

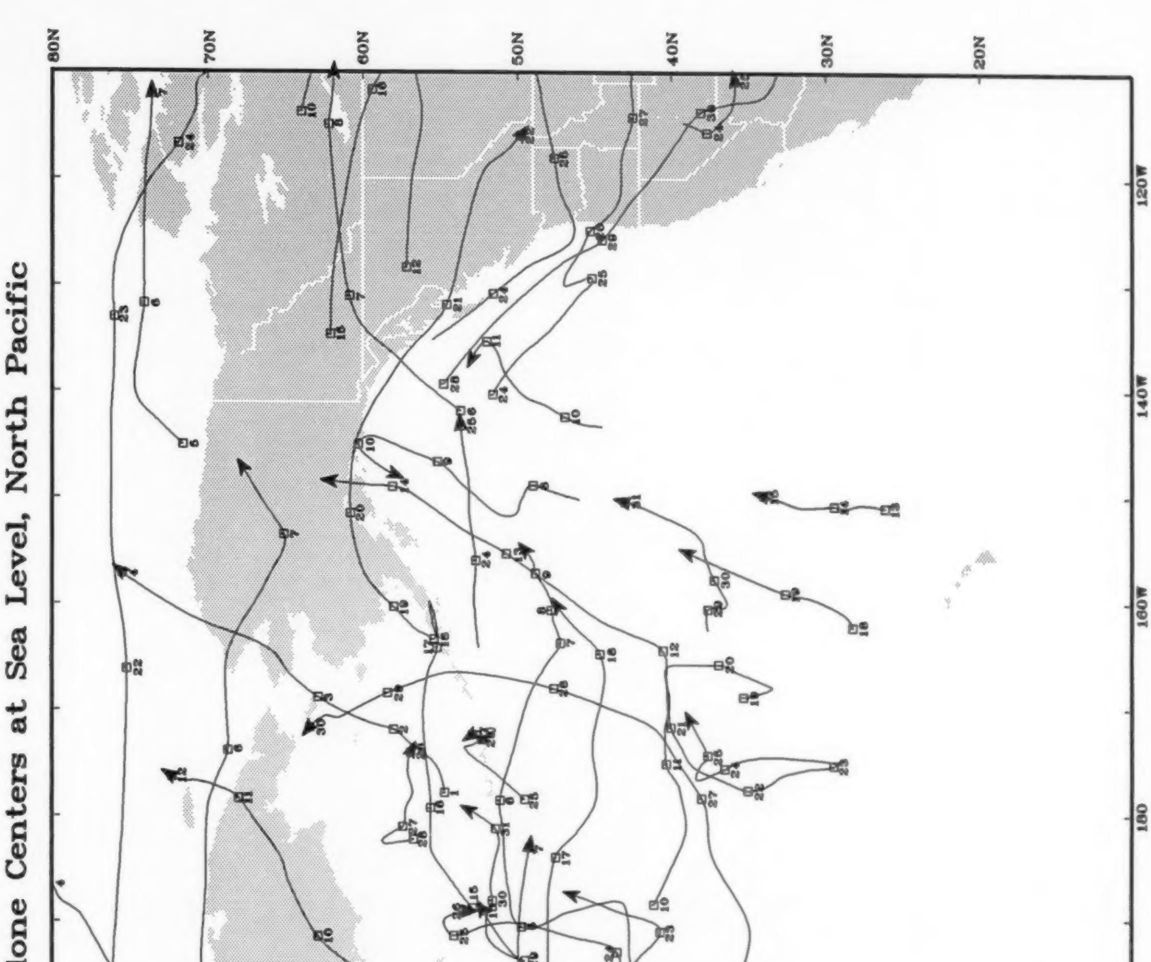


Principal Tracks of Cyclone Centers at Sea Level, North Pacific

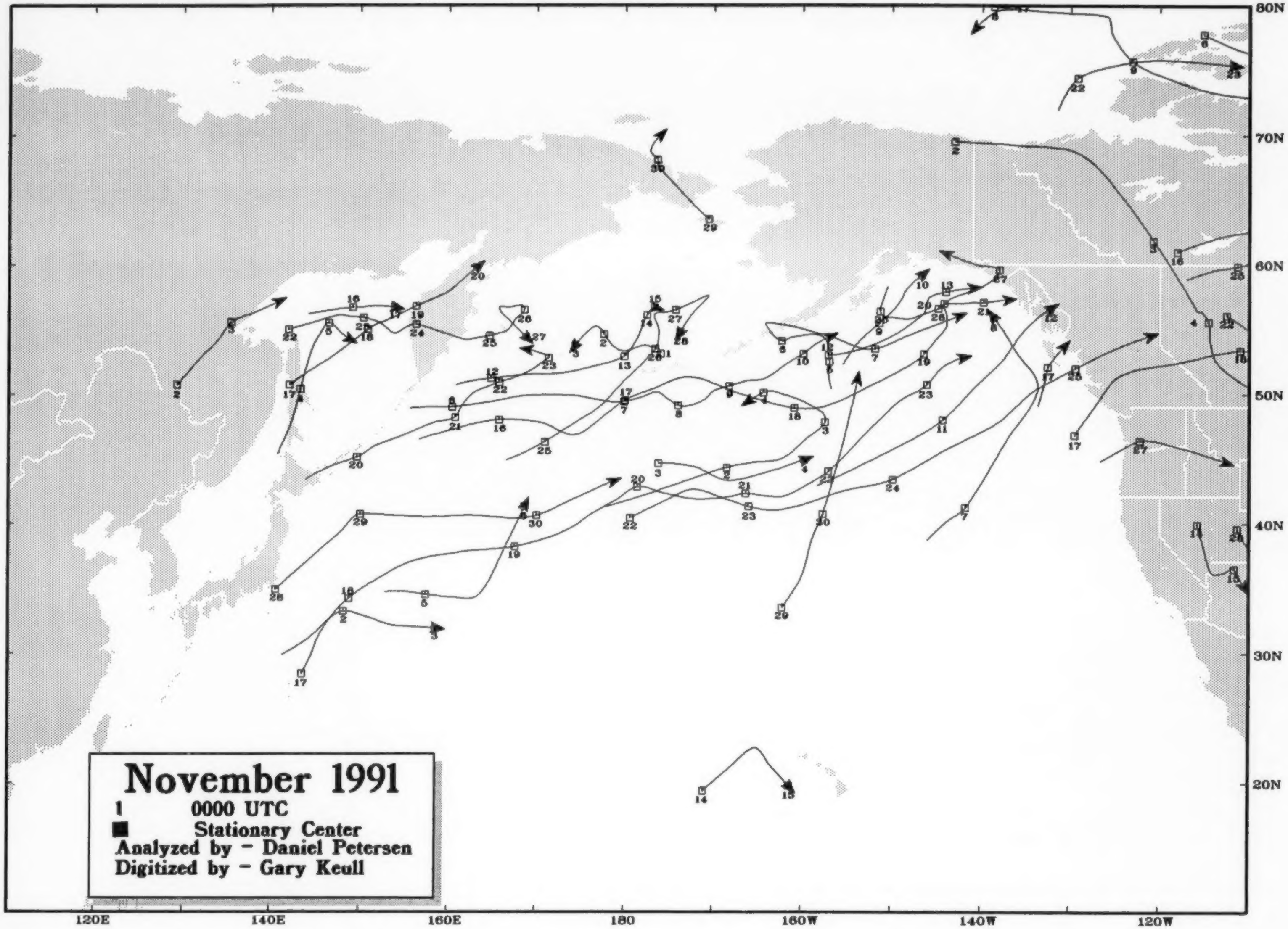


Principal Tracks of Cyclone Centers at Sea Level, North Atlantic

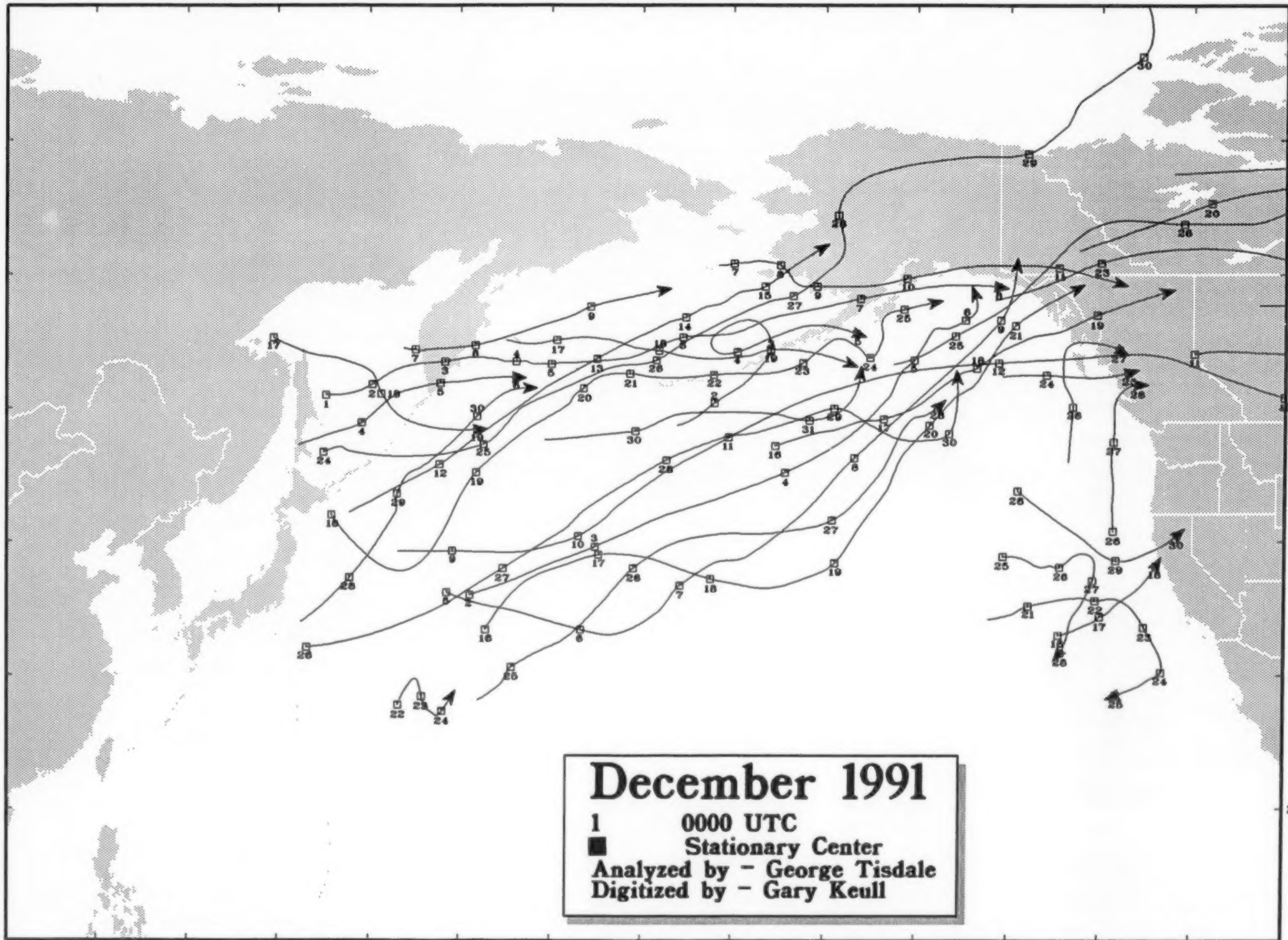



Principal Tracks of Cyclone Centers at Sea Level, North Pacific
October 1991
1 0000 UTC
Stationary Center
Analyzed by - Paul Kocin
and Nicole Vanderzon
Digitized by - Gary Keull
80N
70N
60N
50N
40N
30N
20N
120E
140E
160E
180
160W
140W
120W

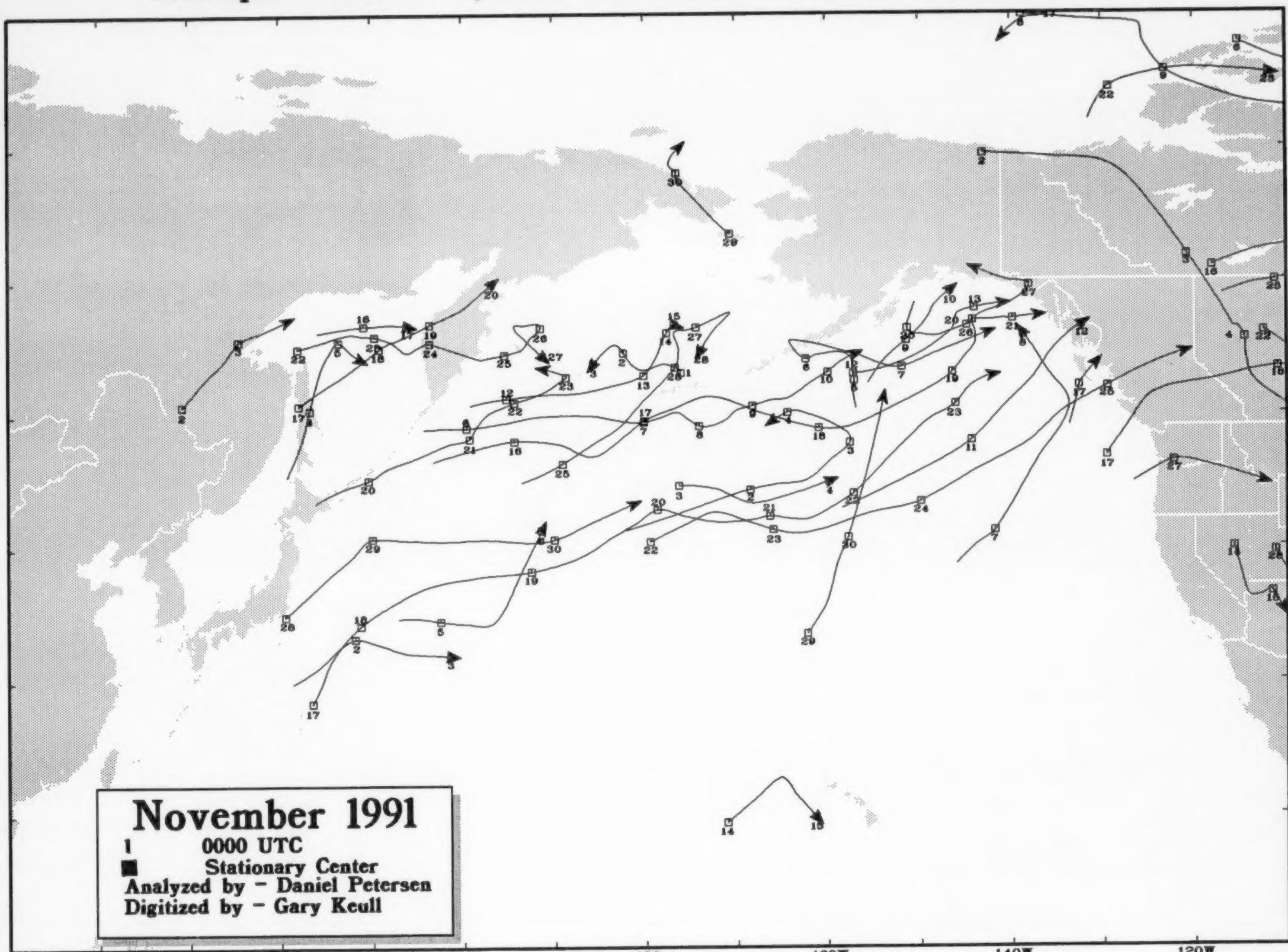
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



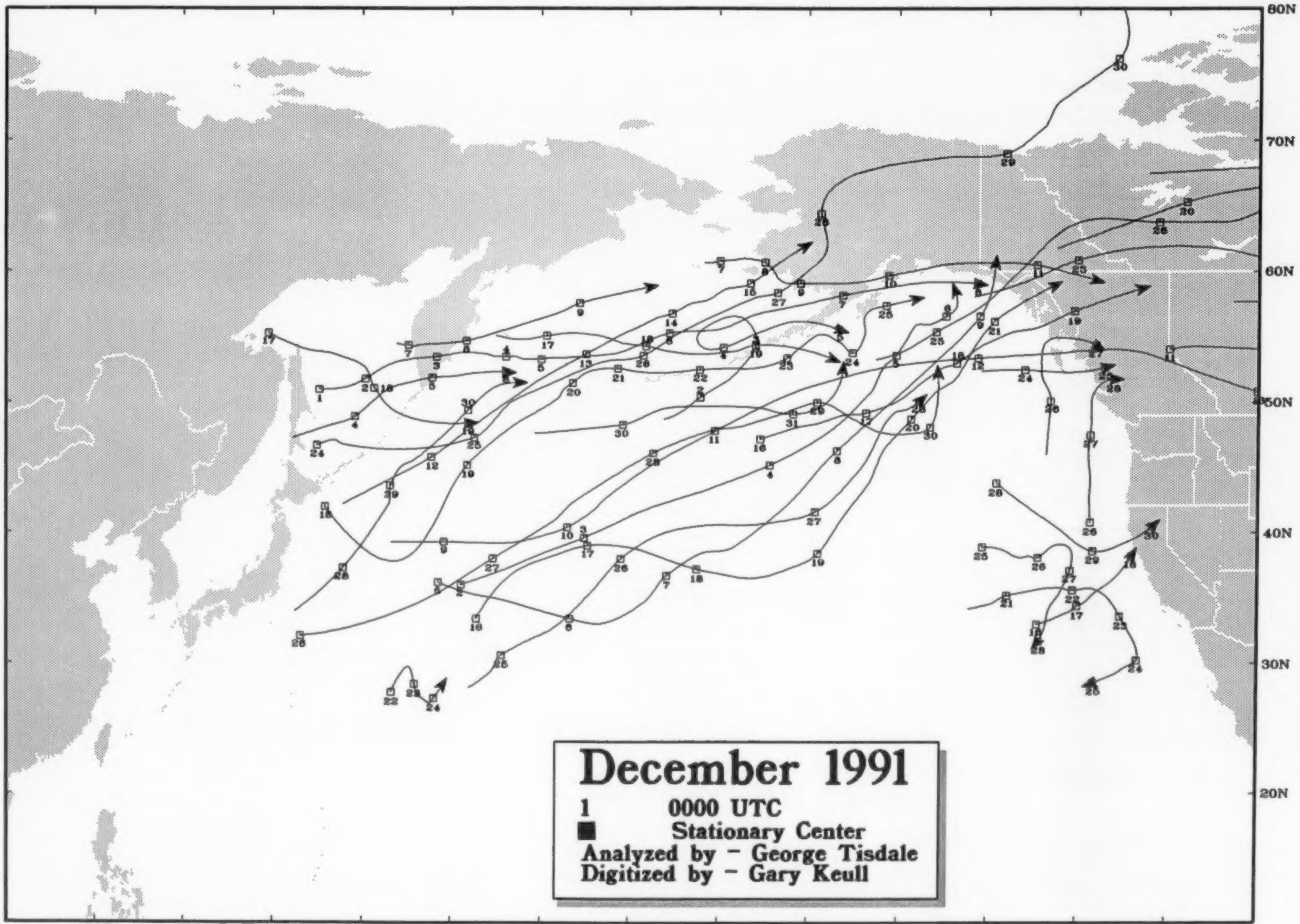
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



October, November and December 1991

VESSEL	CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.	VSBY	PRES WX. code	PRESS-URE mb	TEMP °C. Air	TEMP °C. Sea	SEA WAVES PD sec	SEA WAVES HGT ft.	SWELL WAVES DIR	SWELL WAVES PD sec	SWELL WAVES HGT. ft.
PACIFIC OCT.																		
GEMINI	ELKJ2	1	54.4 N	165.4 W	12	21	M	41	1 NM	64	0993.0	9.0	11.2	7	10	21	6	8
YOUNG SPROUT	3EMQ3	1	52.5 N	173.3 W	18	20	M	42	1 NM		0984.5	8.0	5.0	6	6.5	23	11	11.5
SEALAND PRODUCER	WJBJ	2	36.2 N	155.9 E	12	16	M	40	5 NM	60	1010.8	23.9	24.4	5	11.5	16	8	8
PRESIDENT HOOVER	WTST	2	40.5 N	148.6 E	12	09	M	40	5 NM		1002.8	17.2	15.6			14		10
PRESIDENT MADISON	WCIP	3	48.0 N	156.4 W	06	21		35	5 NM	02	1013.2	13.7	12.2	4	8	31	9	13
SEALAND PRODUCER	WJBJ	3	36.1 N	166.7 E	12	21	M	40	5 NM		1015.1	22.2	23.3	XX	11.5	15	5	11.5
OVERSEAS BOSTON	KRDB	3	58.2 N	142.6 W	18	14		35	5 NM		1015.2	9.4		2	11.5	14	5	13
OVERSEAS BOSTON	KRDB	4	57.1 N	140.6 W	00	16		45	1 NM	63	1010.5	11.1	12.8	4	6.5	16	5	13
ALLIGATOR JOY	3EDD8	4	46.8 N	174.4 E	12	13	M	37	2 NM	81	1001.2	8.0	10.0	5	6.5	14	6	8
BACTAZAR	3EEU6	4	49.3 N	168.4 E	12	13	M	40	1 NM	81	1003.5	11.0	9.0	9	8	12	11	10
ALLIGATOR JOY	3EDD8	5	47.6 N	179.7 E	00	15	M	38	.25 NM	45	1005.5	9.0	10.0	6	10	14	8	10
SEALAND TACOMA	KGTY	5	54.5 N	137.2 W	00	19		36	1 NM	51	1009.9	11.7	11.0	4	8	21	8	11.5
SEALAND PRODUCER	WJBJ	6	41.5 N	161.0 W	12	18	M	54	5 NM		1003.1	15.0	16.1	6	21	XX	XX	8
SOLAR WING	ELJS7	7	38.7 N	154.6 W	00	18	M	42	2 NM	62	1003.6	18.0	22.0	6	23	18	8	26
PRESIDENT MONROE	WNRD	7	23.7 N	122.3 E	12	02	M	38	5 NM	02	1007.2	25.1	26.8	6	13	03	7	14.5
PRESIDENT MONROE	WNRD	8	26.4 N	125.9 E	00	01	M	35	10 NM	02	1004.8	24.7	26.6	6	14.5	02	7	14.5
OVERSEAS JOYCE	WUQL	8	39.3 N	151.9 W	00	21	M	35	5 NM	60	0999.4	21.0	22.0	4	5	23	8	10
NORTHERN LIGHT	WMDG	8	37.5 N	175.5 W	06	30		35	10 NM		1012.5	18.3	18.3	5	11.5	30	6	16.5
LNG VIRGO	WDZX	10	24.1 N	137.9 E	00	22	M	44	5 NM		0995.5	28.0	25.0	5	10	25	11	19.5
LESLIE LYKES	WHTU	10	35.0 N	129.1 E	00	02		35	10 NM		1013.0	20.5	25.0	5	11.5	04	7	13
HOEGH MIRANDA	C6IM7	10	35.8 N	141.4 E	06	05	M	40	5 NM		1008.0	21.3		XX	18	05	XX	18
PRESIDENT ADAMS	WRYW	11	25.6 N	136.4 E	00	25	M	45	5 NM	07	0993.5	27.0	28.2	8	13	28	9	23
OVERSEAS JOYCE	WUQL	11	38.0 N	173.9 W	00	22	M	35	5 NM		0985.0	18.0	19.0	4	8	24	9	13
HANJIN BUSAN	D7EM	12	50.0 N	161.8 W	00	06	M	35	5 NM		1009.0	8.0	10.0	5	19.5	07	6	23
ASTRO JYOJIN	DVUL	12	33.4 N	136.4 E	06	01	M	43	1 NM	60	0998.0	22.0	24.0	13	16.5	14	12	13
CONTIENTAL WING	ELJS6	12	16.6 N	108.8 W	06	19	M	44	2 NM	64	1002.5	23.0	26.0	6	16.5	28	8	14.5
PRESIDENT TYLER	WEZM	12	42.5 N	151.8 W	06	18	M	43	5 NM	02	0998.0	18.9	12.2	9	13	18	11	19.5
PRESIDENT TYLER	WEZM	12	42.2 N	149.2 W	12	19	M	46	5 NM		1003.5	19.4	15.0	12	19.5			
VIKING ACE	ELMR7	13	32.6 N	144.4 E	06	23	M	63			0988.0	27.5	27.0	12	37.5	24	13	42.5
MARINE RELIANCE	WHEJ	13	48.0 N	160.9 W	06	36	M	45	2 NM		0999.0	9.0		4	13	02	12	24.5
MING MOON	BLHO	14	39.7 N	161.9 W	00	02	M	42	5 NM	03	1019.0	16.0	17.0	12	41	20	11	32.5
OVERSEAS JOYCE	WUQL	14	35.5 N	163.9 E	00	20	M	37	10 NM	05	1014.5	26.0		8	5	24	8	11.5
SEALAND TACOMA	KGTY	14	56.3 N	141.9 W	12	25	M	35	10 NM	01	1006.0	8.9	8.7	4	10	25	8	10
TOLUCA	3EFY7	14	41.6 N	177.1 E	18	20	M	35	.5 NM	50	1014.5	15.5		7	13	20	8	16.5
SEALAND TACOMA	KGTY	14	57.2 N	144.6 W	18	23		45	10 NM	15	1005.3	6.7	8.5	4	11.5	23	8	19.5
GREEN SAIKAI	3EVS5	15	49.5 N	159.3 E	00	30	M	35	2 NM	62	0997.5	9.0	9.0	9	14.5	30	8	14.5
ACE ACCORD	DULV	15	39.0 N	146.7 E	00	08	M	39	2 NM	62	1004.0	19.0	25.0	5	19.5	09	4	16.5
SEALAND ENTERPRISE	KRGB	15	43.0 N	173.2 E	00	26	M	35	5 NM		1011.1	15.0	11.1	7	13	22	10	11.5
ARTHUR MAERSK	OXRS2	15	45.0 N	168.9 E	00	26		36	2 NM		1004.8	12.0		5	6.5	27	10	13
MARINE RELIANCE	WHEJ	15	42.1 N	174.9 W	06	19	M	40	5 NM		1017.5	13.5		5	8	23	5	6.5
SALINAS	3EPF3	16	43.9 N	153.8 E	00	20	M	40	5 NM		1002.5	11.0	11.0	7	19.5	18	12	19.5
NOAA SHIP MCARTHUR	WTEJ	19	39.3 N	127.2 W	18	01	M	35	5 NM		1025.9	19.0	15.5	2	5	01	7	8
HANEI SKY	3EZM3	21	46.9 N	174.3 W	00	05	M	40	5 NM		1027.0	8.0	9.0	8	11.5	07	8	11.5
LNG TAURUS	WDZW	21	22.9 N	122.0 E	00	05	M	40	2 NM		1017.0	22.0	28.3	6	16.5	05	6	16.5
SEALAND PRODUCER	WJBJ	21	25.0 N	177.9 E	00	06	M	35	10 NM		1016.0	23.3	23.9	5	13	03	8	10
PRESIDENT HOOVER	WTST	21	46.4 N	171.1 E	00	18	M	36	2 NM		1022.8	8.9	8.3	5	10	17	12	19.5
GREEN BAY	KGTH	21	48.2 N	174.7 E	06	16	M	35	.5 NM	80	1026.3	7.0	6.0	7	8	16	8	10
SEALAND TACOMA	KGTY	21	50.8 N	132.4 W	12	31	M	36	5 NM	80	1014.6	10.0	12.5	5	11.5	30	12	16.5
CONTIENTAL WING	ELJS6	22	32.5 N	177.8 E	06	33	M	36	10 NM		1009.5	19.5	23.0	8	16.5	34	8	16.5
NARA	LXNF	22	14.5 N	142.7 E	12	11	M	48	200 YD	82	1001.2	26.2	29.0			11	6	24.5
CHEVRON CALIFORNIA	WCGN	22	49.8 N	129.7 W	12	34	M	36	10 NM		1011.2	9.4	12.2	4	8	33	5	10
SEALAND INNOVATOR	WGKF	22	25.2 N	120.4 E	12	05	M	35	10 NM	02	1019.0	22.8		2	10	05	5	14.5
MANUKAI	KNLO	23	32.4 N	147.9 W	00	06		35	10 NM	01	1018.6	24.0	20.0	4	8	08	8	10
NARA	LXNF	24	08.9 N	144.0 E	00	26	M	43	200 YD	82	1009.1	29.0	28.5	5	10	23	9	19.5
SEALAND RELIANCE	WFLH	25	34.8 N	141.1 E	06	01	M	35	5 NM	64	1013.6	17.8	21.1	4	6.5	02	8	13
PRESIDENT TRUMAN	WNDP	25	34.6 N	141.6 E	06	34	M	38	5 NM		1013.0	17.8	25.6	12	14.5	35	14	11.5
PRESIDENT TRUMAN	WNDP	25	36.2 N	143.6 E	12	36	M	39	5 NM		1015.0	18.8	22.7	12	14.5	35	10	6.5
SEALAND INNOVATOR	WGKF	25	37.9 N	149.1 E	18	31	M	49	10 NM	03	1012.0	20.0		3	8	09	7	14.5
GREEN BAY	KGTH	26	48.5 N	133.7 W	06	36	M	38	5 NM	25	1011.2	9.0	13.0	8	13	36	12	16.5
SEALAND HAWAII	KIRF	26	37.5 N	167.5 E	06	11		40	2 NM	82	1004.0	16.1	21.7	6	10			
EXXON SAN FRANCISCO	KAAC	27	57.6 N	141.1 W	18	16	M	38	5 NM	80	1017.4	3.9	11.7	2	8	15	2	6.5
SEALAND CONSUMER	WCHF	27	32.5 N	121.3 W	18	32		35	10 NM		1016.0	15.6	15.6	7	13	33	12	11.5
MARINE RELIANCE	WHEJ	27	47.1 N	174.4 E	18	31	M	40	10 NM	20	1000.0	7.5		5	13	31	10	19.5
EXXON SAN FRANCISCO	KAAC	28	58.4 N	142.4 W	00	14	M	39	2 NM	53	1015.1	4.4	11.7	3	14.5	14	2	8
SEALAND EXPRESS	KGJD	28	24.1 N	120.1 E	03	03	M	60	1 NM	81	1002.9	20.0				36	3	44
GEMINI	ELKJ2	28	50.4 N	164.6 W	06	18	M	40	< 50 YD	45	0973.0	9.0	9.0	9	14.5	18	8	11.5
SEALAND RELIANCE	WFLH	29	49.6 N	173.3 W	18	13		40	2 NM	81	0992.8	6.7	6.7	8	11.5			
ALLIGATOR HOPE	ELFN8	30	41.7 N	164.2 E	00	29	M	36	5 NM		1006.0	11.0	13.0	10	13	27	10	16.5
NOAA SHIP MCARTHUR	WTEJ	30	38.4 N	125.1 W	00	25	M	36	5 NM		1019.7	15.1	14.2	3	5	35	7	10
NOAA SHIP MCARTHUR	WTEJ	30	38.1 N	124.5 W	03	24	M	36	5 NM		1019.1	13.9	13.9	3	5	35	7	10
MANULANI	KNIJ	30	35.1 N	144.9 W	06	14		35	1 NM	81	1019.7	22.8	22.8	6	19.5	13	12	23
MANULANI	KNIJ	30	36.7 N	143.2 W	12	15		35	5 NM	80	1020.5	21.7	22.2	6	19.5	13	12	16.5

October, November and December 1991

VESSEL	CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.	VSBY	PRES WX. code	PRESSURE mb	TEMP °C. Air	TEMP °C. Sea	SEA WAVES PD sec	SEA WAVES HGT ft.	SWELL WAVES DIR	SWELL WAVES PD sec	SWELL WAVES HGT. ft.
HANJIN TONGHAE	D7PT	31	46.4 N	179.8 W	00	25	M	40	10 NM		0993.4		9.0	9	10			
ALLIGATOR HOPE	ELFN8	31	44.2 N	174.5 E	00	28	M	35	5 NM		1002.5	9.0	10.0	8	14.5	29	14	16.5
LNG AQUARIUS	WSKJ	31	24.6 N	126.4 E	02	01	M	80	.25 NM	07	0996.0	24.5	25.6	7	16.5	01	8	19.5
SEALAND RELIANCE	WFLH	31	51.4 N	154.3 W	06	16	M	35	1 NM	12	0999.0	10.0	7.8	4	6.5			
LNG AQUARIUS	WSKJ	31	25.2 N	127.0 E	06	01	M	59	.5 NM	63	1001.0	24.0	25.6	12	26			
ATLANTIC OCT.																		
USNS JOHN LENTHAL	NJLN	2	32.2 N	78.8 W	06	11	M	35	5 NM		1014.0	25.6	27.2	2	6.5	10	5	11.5
ARCTIC DISCOVERER	V2ZD1	2	32.0 N	77.0 W	12	10		40	50 YD	81	1012.9	23.0		11	13			
FETISH	OXBM6	4	41.4 N	52.2 W	18	18	M	38	5 NM	15	1017.0	24.0	24.0	9	11.5	19	10	10
HUAL LISITA	LAXK2	5	47.9 N	10.3 W	06	34	M	39	10 NM		1020.0	13.0	16.0	6	16.5	34	10	14.5
SEALAND PERFORMANCE	KRPD	6	49.6 N	17.3 W	12	27	M	37	1 NM	25	1010.5	15.0	15.3	5	16.5	XX	8	19.5
HUAL LISITA	LAXK2	7	44.4 N	24.9 W	00	32	M	39	10 NM		1021.0	16.0	20.0	9	19.5	32	10	21
USNS JOHN LENTHAL	NJLN	7	31.5 N	79.1 W	06	35	M	35	> 25 NM	03	1016.0	22.2	28.1	1	5	30	4	5
HUAL LISITA	LAXK2	7	43.8 N	28.5 W	12	34	M	44	10 NM		1027.5	15.0	20.0	10	23	34	10	24.5
FETISH	OXBM6	9	47.0 N	23.2 W	06	35	M	37	5 NM		1020.3	12.0	16.0	10	14.5	34	14	19.5
AUSTRAL LIGHTNING	WEZA	9	36.1 N	22.1 W	06	33	M	40	10 NM		1016.5	17.0	20.6	2	8	33	9	18
FETISH	OXBM6	9	47.3 N	22.2 W	12	02	M	42	5 NM		1018.9	16.0		10	16.5	01	14	21
AUSTRAL LIGHTNING	WEZA	9	36.5 N	23.6 W	12	33	M	40	10 NM		1016.7	20.0	20.6	2	8	33	9	18
HUAL LISITA	LAXK2	10	41.4 N	51.8 W	06	05	M	35	5 NM		1023.5	12.0	17.0	7	13	05	11	13
FETISH	OXBM6	10	48.2 N	18.9 W	06	01	M	35	5 NM		1011.3	14.0	16.0	10	13	04	13	16.5
FAUST	WRYX	12	48.9 N	25.5 W	06	28	M	40	5 NM		1014.5	15.2	14.0	3	10	29	7	16.5
CHICKASAW	VPHB	13	51.0 N	39.7 W	18	24		35	1 NM		1015.0	14.0	12.0	6	16.5	24	7	10
HUAL ANGELITA	LAFB4	16	49.9 N	03.0 W	12	23	M	45	5 NM	60	1005.0	15.0	16.0	15	23	23	15	23
NUEVO SAN JUAN	KEOD	16	27.0 N	76.6 W	21	23		35	5 NM	81	1007.5	26.1	27.8	4	13	18	9	13
HUAL ANGELITA	LAFB4	17	47.8 N	09.2 W	06	32	M	35	10 NM	01	1007.0	13.0	15.0	15	23	32	15	23
ATLANTIC SENTRY	NJAS	17	20.3 N	72.0 W	06	11	M	44	5 NM		1012.5	28.0		3	8			
SCARAB	OVRE2	17	39.1 N	41.9 W	18	32		35	5 NM	60	1010.2	17.0		10	16.5	33	12	19.5
SCARAB	OVRE2	18	39.1 N	42.2 W	00	33		47	2 NM		1009.0	17.8		12	31			
ROBERT E. LEE	KCRD	19	34.6 N	22.9 W	06	23	M	35	5 NM		1010.0	21.1	20.1	8	6.5	25	9	13
ROBERT E. LEE	KCRD	19	34.8 N	24.8 W	12	16	M	35	5 NM	25	1010.0	22.8	21.0	9	6.5	23	12	16.5
TYSON LYKES	WMLG	20	37.8 N	56.6 W	00	31	M	36	10 NM	18	1005.2	21.7		4	6.5	31	7	16.5
FAUST	WRYX	20	45.1 N	25.3 W	18	10	M	35	1 NM		1017.0	18.2	17.8	3	8	14	5	13
HUAL ANGELITA	LAFB4	21	46.2 N	45.2 W	00	32	M	35	.5 NM	41	0997.0	10.0	10.0	15	18	32	15	18
HUAL ANGELITA	LAFB4	21	45.7 N	50.0 W	12	28	M	35	5 NM	01	1007.0	9.0	8.0	15	18	28	15	18
HUAL ANGELITA	LAFB4	21	45.4 N	52.3 W	18	28	M	40	5 NM		1010.5	9.0	10.0	17	23	28	17	23
HUAL ANGELITA	LAFB4	22	45.2 N	54.5 W	00	28	M	50	5 NM	01	1017.0	8.0	9.0	17	23	28	17	23
MARGARET LYKES	KRJL	29	39.2 N	53.6 W	03	15		37	5 NM	02	1007.0	23.4	19.0	5	8	20	9	13
MARGARET LYKES	KRJL	29	39.4 N	54.5 W	06	15		37	2 NM	25	1002.7	22.2	19.0	5	11.5	19	9	13
MARGARET LYKES	KRJL	29	39.1 N	54.9 W	09	26		40	10 NM	02	0996.9	23.3	19.0	5	14.5	26	6	13
MARGARET LYKES	KRJL	30	39.1 N	61.0 W	06	10		40	10 NM	03		18.9	20.0	5	11.5	04	9	28
JACKSONVILLE	WNDG	30	26.6 N	70.5 W	06	36		35	10 NM	25	1014.8	23.3	26.7	8	14.5	36	10	19.5
MARGARET LYKES	KRJL	30	39.4 N	62.2 W	09	12		40	10 NM	02		18.9	20.0	6	11.5	04	9	26
MARGARET LYKES	KRJL	31	40.0 N	69.2 W	12	31		42	10 NM	02	1008.9	16.7	16.0	6	13	14	6	13
PACIFIC NOV.																		
YOUNG SPROUT	3EMQ3	1	44.7 N	160.0 E	00	29	M	44	1 NM		0997.0	8.0	4.0	4	8	30	9	14.5
PRESIDENT ADAMS	WRYW	1	37.2 N	172.4 E	00	29	M	35	5 NM		1001.5	19.0	17.6	6	11.5	26	10	16.5
YOUNG SPROUT	3EMQ3	1	44.9 N	162.2 E	06	32	M	36	.5 NM	45	0997.0	9.0	4.0	4	8	31	9	14.5
OOCL EXECUTIVE	D5AN	1	43.2 N	177.3 E	06	27		40	.5 NM	62	0985.0	14.0	14.0	8	11.5	08	3	3
ALTAMONTE	DZBD	2	46.3 N	167.4 W	00	11	M	37	.25 NM	45	0994.0	11.0		5	8	12	8	11.5
SEALAND KODIAK	KGTZ	2	54.5 N	137.2 W	00	11	M	45	2 NM	61	1013.5	9.4	8.0	8	13	13	10	13
CHEVRON CALIFORNIA	WCGN	2	55.6 N	140.3 W	00	11	M	36	2 NM		1011.0	8.9	8.9	5	14.5	14	8	14.5
SEALAND SPIRIT	WFLG	2	32.0 N	149.5 W	00	21	M	40	5 NM	18	1005.9	27.8	24.4	8	16.5	26	9	18
ALASKA RAINBOW	3ECL4	2	53.2 N	145.2 W	06	28	M	35	.25 NM	60	0999.0	11.0	13.0	12	16.5	28	12	16.5
YOUNG SPROUT	3EMQ3	2	46.1 N	169.5 E	06	31	M	46	.5 NM	45	0997.0	5.0	4.0	4	8	31	9	14.5
MING SUN	BLHN	2	36.5 N	152.5 W	06	19	M	38	5 NM		1008.0	22.0	17.0	8	13			
TONCI TOPIC	ELKX	2	45.1 N	157.5 W	06	15		44	2 NM	59	0986.0	14.0	15.0	12	23			
TONCI TOPIC	ELKX	3	46.0 N	154.4 W	00	22		37	.5 NM	59	0976.0	15.0	15.0	10	13			
GREEN BAY	KGTH	3	54.3 N	164.0 W	00	07	M	40	2 NM	15	0992.0	9.5	7.0	5	11.5	06	7	13
SEALAND ANCHORAGE	KGTX	3	54.1 N	157.6 W	00	08		37	5 NM		0993.3	7.8	8.4	4	6.5	08	10	13
EMERALD SEA	LAHA2	3	43.9 N	155.8 W	00	26	M	40	2 NM		0985.0	13.0	13.0	6	16.5	24	7	19.5
RUBIN OCEAN	DUVV	3	41.2 N	176.9 W	04	31	M	48	5 NM	80	0996.0	10.0	13.4	9	18	30	9	19.5
OCEAN ASPIRATION	3EJB3	4	54.2 N	142.7 W	18	12	M	37	1 NM		0992.0	10.0	10.0	9	14.5	14	10	16.5
ALLIGATOR JOY	3EDD8	5	38.9 N	149.7 E	18	29	M	38	2 NM	25	1023.0	15.0	20.0	4	6.5	27	7	10
SEALAND KODIAK	KGTZ	5	56.7 N	147.7 W	18	14	M	38	2 NM	63	0988.0	10.0	10.0	XX	13	14	XX	14.5
PRESIDENT HOOVER	WTST	5	41.3 N	148.2 E	18	32	M	43	10 NM		1021.5	2.1	9.4	4	10	32	9	19.5
GREEN SUMA	3EVE5	6	44.5 N	165.4 E	06	26	M	40	1 NM		1000.0	8.0	1.2	10	11.5	26	12	13
MAERSK PINE	GKJJ	6	46.7 N	155.8 E	06	27		39	5 NM		0993.0	4.0		6	11.5	28	7	13
PRESIDENT EISENHOWER	KRJG	6	43.3 N	179.2 E	18	25	M	38	10 NM		0997.0	12.0	11.6	4	16.5	25	6	16.5
ALLIGATOR JOY	3EDD8	7	41.1 N	161.3 E	00	29	M	43	5 NM		1014.0	8.0	14.0	5	8	29	7	11.5
PRINCE OF TOKYO 2	3EUU6	7	48.7 N	176.4 W	00	24	M	40	10 NM	03	0979.8	7.0	3.0	10	16.5	24	12	19.5
ALLIGATOR JOY	3EDD8	7	41.3 N	163.6 E	06	30	M	37	5 NM		1011.5	12.0	15.0	5	8	29	7	11.5
SEALAND KODIAK	KGTZ	7	50.4 N	129.6 W	12	15	M	50	5 NM	61	1003.5	12.2	11.0	XX	16.5			
MADISON MAERSK	OVJB2	8	35.7 N	142.4 E	06	16	M	38	1 NM	58	1012.0		24.7	8	16.5			

October, November and December 1991

VESSEL	CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.	VSBY	PRES WX. code	PRESSURE mb	TEMP °C. Air	TEMP °C. Sea	SEA WAVES PD sec	SEA WAVES HGT ft.	SWELL WAVES DIR	SWELL WAVES PD sec	SWELL WAVES HGT. ft.
PRESIDENT GRANT	WEZD	9	42.0 N	154.8 E	00	17		40	10 NM		1016.8	14.4	15.0	4	6.5	16	7	8
PRESIDENT JACKSON	WRYC	9	41.8 N	148.1 E	00	22	M	45	200 YD	82	0998.8	12.2	8.5	7	6.5	16	7	10
GREEN BAY	KGTH	9	37.8 N	147.6 E	02	31	M	73	.5 NM	15	0999.5	17.0	20.0	8	26	31	12	29.5
SEALAND LIBERATOR	KHRP	9	40.7 N	153.0 E	06	14	M	38	2 NM	62	1004.1	16.2		4	3	15	4	11.5
PRESIDENT GRANT	WEZD	9	42.9 N	157.1 E	06	17		40	10 NM		1014.0	12.8	11.7	4	6.5	18	8	6.5
SEALAND SPIRIT	WFLG	9	43.8 N	169.8 E	06	33	M	36	10 NM	01	1015.5	7.8	6.1	8	19.5	33	12	16.5
PRESIDENT JACKSON	WRYC	9	40.3 N	146.3 E	06	31	M	35	10 NM		10C5.0	11.0	9.6	6	10	15	8	11.5
HANEI SKY	3EZM3	10	54.1 N	162.0 W	12	32	M	35	10 NM	07	0990.0	7.0	8.0	6	8	32	6	8
NEPTUNE AMBER	S6CY	10	35.3 N	157.7 W	18	28	M	35	5 NM	03	1016.5	17.5		2	8	28	5	11.5
PRESIDENT MADISON	WCIP	10	50.9 N	161.2 E	18	24		37	10 NM		1006.0	6.1	5.0	8	8	18	10	16.5
ASTRO JYOJIN	DVUL	11	54.2 N	163.9 W	00	36	M	38	2 NM	68	0984.2	0.5	7.5	6	8	32	6	8
PRESIDENT MADISON	WCIP	11	50.2 N	158.8 E	00	19		40	10 NM	03	1009.1	6.1	5.0	8	8	21	11	16.5
PRINCE OF TOKYO 2	3EUU6	11	49.4 N	136.2 W	18	25	M	45	5 NM	03	0996.5	11.0	7.0	14	23	25	14	23
OVERSEAS BOSTON	KRDB	11	50.3 N	132.3 W	18	24		45	5 NM		0990.5	12.7	13.0	3	8	24	10	16.5
PACMERCHANT	5MCB	11	52.8 N	142.9 W	21	24	M	35	10 NM	04	0991.0	10.0	11.0	7	10	26	10	14.5
OVERSEAS BOSTON	KRDB	12	50.5 N	133.0 W	00	25		45	10 NM		0998.3	13.3	13.0	4	8	24	10	16.5
PRESIDENT LINCOLN	KDBG	12	22.6 N	121.3 E	06	03		36	5 NM	05	1014.4	25.2	26.7	9	10	03	11	13
NOSAC EXPRESS	LAZA2	12	42.5 N	164.9 E	06	31	M	35	5 NM		1006.7	9.2	9.0	5	11.5	17	17	8
HANEI SKY	3EZM3	13	53.5 N	172.3 E	18	28	M	40	2 NM	07	0983.0	4.0	7.0	7	10	27	8	10
ASTRO JYOJIN	DVUL	13	51.5 N	167.7 E	18	27	M	37	5 NM	03	0986.5	4.0	7.0	4	8	24	7	11.5
ALLIGATOR PRIDE	ELJO8	13	53.6 N	177.8 W	18	26	M	44	5 NM	03	0970.9	6.0	6.3	11	6.5	26	14	8
EDEN	ELKK3	13	50.5 N	177.3 W	18	26	M	40	5 NM	27	0988.0	4.0	8.0	9	18	28	10	23
PRESIDENT GRANT	WEZD	13	50.0 N	153.5 W	18	23		38	2 NM	10	0999.9	10.0	10.0	5	11.5	20	8	11.5
PRESIDENT TYLER	WEZM	13	40.0 N	173.3 W	18	35	M	38	2 NM	63	1004.8	8.9	11.7	6	8	20	12	13
HANEI SKY	3EZM3	14	53.6 N	170.6 E	00	28	M	40	10 NM	07	0981.0	5.0	7.0	7	10	27	8	10
OOCL EXECUTIVE	D5AN	14	54.0 N	173.5 W	00	26		43			0973.0	8.0	7.0	8	11.5	25	8	11.5
SEALAND TRADER	KIRH	14	47.2 N	158.0 W	00	22		36	.5 NM	63	0998.1	9.4	8.3	4	13	24	15	18
CONTIENTAL WING	ELJS6	15	45.5 N	179.2 E	12	28	M	40	5 NM	02	1000.5	6.5	7.0	6	19.5	28	12	19.5
KEYSTONE CANYON	KSFK	15	50.5 N	131.5 W	12	22		40	2 NM	81	0996.0	11.5		6	10	20	7	23
SEALAND CONSUMER	WCHF	15	45.5 N	177.1 E	12	27		40	5 NM	25	0999.1	5.0	5.0	5	8	28	16	34.5
PRESIDENT GRANT	WEZD	15	49.2 N	133.4 W	12	21		45	1 NM	81	0992.6	13.3	12.8	5	11.5	21	11	21
GREAT LAND	WFDP	15	49.3 N	127.1 W	12	14	M	37	2 NM	63	1015.3	10.3	11.1	3	10	17	8	18
OVERSEAS BOSTON	KRDB	16	55.7 N	138.8 W	18	06		35	10 NM		1013.2		0.7	3	8	29	16	8
KEYSTONE CANYON	KSFK	16	53.2 N	136.4 W	18	04		43	2 NM		0967.0	8.3	11.7	7	16.5	04	7	23
CHEVRON CALIFORNIA	WCGN	16	44.7 N	151.9 W	18	26	M	35	5 NM	03	0995.5	10.6	11.1	3	8	27	5	10
OVERSEAS BOSTON	KRDB	17	54.6 N	137.5 W	00	34		40	10 NM			7.2		4	8	30	12	10
KEYSTONE CANYON	KSFK	17	53.7 N	137.0 W	00	35		40	2 NM		0968.5	8.9	10.6	6	16.5	36	9	24.5
PRESIDENT TYLER	WEZM	17	39.1 N	139.0 W	00	27	M	36	10 NM	15	1007.0	17.2	16.7	10	14.5	27	15	23
NATIONAL HONOR	DZDI	17	42.6 N	146.8 W	06	27	M	36			0995.6	9.0	10.0	10	26	27	15	34.5
CONTIENTAL WING	ELJS6	18	47.8 N	152.4 W	12	23	M	48			0981.5	8.5	9.0	6	16.5	23	12	16.5
CONTIENTAL WING	ELJS6	18	48.3 N	148.9 W	18	25	M	47	2 NM		0980.0	7.0	9.0	8	19.5	25	10	16.5
SEALAND KODIAK	KGTZ	18	49.4 N	133.6 W	18	17	M	35	10 NM	25	1000.6	10.6	10.0	4	8	26	9	16.5
WESTWOOD JAGO	C6CW9	19	40.5 N	176.2 E	06	12	M	68	200 YD	63	0997.5	11.0		12	19.5			
CONTIENTAL WING	ELJS6	19	49.0 N	143.5 W	06	25	M	39	2 NM		0983.0	9.0	10.0	6	18	22	10	16.5
OVERSEAS JUNEAU	WWND	19	42.7 N	125.8 W	18	18		35	5 NM		1017.2	13.3	10.6	7	13	18	8	8
BAY BRIDGE	ELES7	20	48.9 N	152.9 W	00	28	M	42	10 NM		1005.0	3.5	8.0	12	18	28	11	16.5
M.V. CALIFORNIA HERMES	ELJP6	20	50.7 N	141.5 W	00	24	M	40	5 NM		0990.5	5.5	10.0	9	18	33	9	19.5
ADMIRALTY BAY	KACK	20	53.6 N	137.9 W	00	25		40	5 NM		0986.2	7.8	8.3	7	14.5	23	13	21
WESTWOOD JAGO	C6CW9	20	41.2 N	178.1 W	06	31	M	50	200 YD	45	0987.5	9.0		14	39			
SEALAND EXPLORER	WGJF	21	33.8 N	166.2 W	06	29	M	45	5 NM	01	1012.0	16.0	18.0	7	6.5	27	16	18
OVERSEAS BOSTON	KRDB	21	51.5 N	133.5 W	12	14		40	2 NM		0995.3	10.1	10.0	5	11.5	30	15	13
OVERSEAS BOSTON	KRDB	21	52.9 N	135.3 W	18	20		40	5 NM		0993.2	9.4	10.0	7	11.5	20	8	14.5
SEALAND ENTERPRISE	KRGB	21	46.9 N	145.8 W	18	12	M	36	10 NM		1015.2	10.6	8.9	8	13	31	12	16.5
PRESIDENT ADAMS	WRYW	21	43.4 N	145.3 W	18	12	M	48	1 NM	63	1012.2	14.0	14.1	6	11.5	33	9	13
PACIFIC EMERALD	DUPG	22	49.8 N	166.9 W	00	08	M	36			1010.5	6.0	7.0	9	11.5	07	9	11.5
EASTERN VENTURE	3EYQ5	22	48.7 N	140.7 W	06	12	M	45	2 NM	50	1009.5	10.0	11.0	12	19.5	12	12	19.5
ALTAMONTE	DZBD	23	54.0 N	155.0 W	00	35	M	39	1 NM		0998.0	3.0		5	10	36	7	13
ASPEN	KACN	23	51.1 N	135.2 W	00	15		40	10 NM	58	1000.0	12.2	10.6	6	16.5	15	14	34.5
SEALAND KODIAK	KGTZ	23	54.1 N	136.3 W	00	14	M	46	1 NM	61	0997.5	9.2	8.0	6	13	15	12	23
SEALAND ENTERPRISE	KRGB	23	48.2 N	133.2 W	00	17	M	45	2 NM	80	1004.5	12.8	10.6	7	21	17	12	29.5
SEALAND ANCHORAGE	KGTX	23	54.1 N	160.9 W	12	33		40	10 NM	01	0999.5	0.6	5.0	6	14.5	34	10	16.5
OVERSEAS BOSTON	KRDB	24	53.6 N	136.6 W	00	27		35	5 NM	02	0995.6	7.8	10.0	4	6.5	22	10	11.5
ARTHUR MAERSK	OXRS2	25	43.0 N	159.6 E	06	27		35	5 NM	02	1005.0	5.5		XX	19.5			
ARTHUR MAERSK	OXRS2	25	43.1 N	165.2 E	18	30		35	5 NM		1006.5	3.5		XX	19.5			
SEALAND PATRIOT	KHRF	26	42.9 N	177.3 E	00	29	M	38	10 NM	03	1004.8	9.5		5	6.5	23	10	13
SKAUGRAN	LADB2	27	54.3 N	159.5 W	00	24	M	37	5 NM		0994.5	6.5		3	8	24	6	13
OCEAN SEL	3ETR3	27	50.8 N	150.2 W	12	23	M	36	2 NM	07	1018.0	10.0	9.0	7	10	23	9	13
OVERSEAS BOSTON	KRDB	27	58.1 N	142.1 W	18	26		35	5 NM		1007.5	5.6	9.0	5	6.5	26	6	13
SKAUGRAN	LADB2	27	54.2 N	164.1 W	18	21	M	39	5 NM	40	1008.0	5.5	9.5	6	16.5	23	7	19.5
OVERSEAS BOSTON	KRDB	28	57.3 N	140.7 W	00	29		35	5 NM		1012.2	7.2	9.0	5	6.5	26	6	13
CHEVRON SKY	5LTC	28	35.1 N	149.2 W	12	08	M	36	10 NM		1026.4	19.0	18.0	3	10	08	4	10
PRESIDENT F. ROOSEVELT	KRJF	28	44.1 N	157.7 W	12	14	M	42	2 NM		1012.0	11.7	10.0	12	13	19	16	16.5
ANDERS MAERSK	OXIT2	30	36.0 N	124.2 W	00	35		44	10 NM		1021.0	13.0		8	11.5	35	19	26

October, November and December 1991

VESSEL	CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.	VSBY	PRES WX. code	PRESSURE mb	TEMP °C. Air	TEMP °C. Sea	SEA WAVES PD sec	SEA WAVES HGT ft.	SWELL WAVES DIR	SWELL WAVES PD sec	SWELL WAVES HGT. ft.
M/V VERA ACORDE	3EAG4	30	38.8 N	161.2 E	06	30	M	40	2 NM		1013.0	10.0	18.0	10	23	30	12	23
ATLANTIC NOV.																		
CRISTOFORO COLOMBO	ICYS	1	42.1 N	43.3 W	00	35		35	1 NM		1010.0	10.0	16.0	5	13			
CRISTOFORO COLOMBO	ICYS	1	42.2 N	45.4 W	06	36		45	5 NM		1020.0	11.0	17.0	4	14.5			
CRISTOFORO COLOMBO	ICYS	2	42.9 N	52.3 W	00	22		35	5 NM	02	1017.0	12.0	6.0	4	10			
MARGRETHE MAERSK	OYSN2	2	55.3 N	26.7 W	12	30	M	45	2 NM		0995.3	7.3	9.4	6	19.5			
MARGRETHE MAERSK	OYSN2	2	54.3 N	28.8 W	18	30	M	52	5 NM		1003.0	6.0	9.7	6	23			
MARGRETHE MAERSK	OYSN2	3	52.7 N	30.6 W	00	30	M	53	5 NM		1003.0	9.5	9.4	6	19.5			
NOAA SHIP WHITING	WTEW	3	27.8 N	96.9 W	15	02	M	35	5 NM	00	1035.0	8.0	20.5	2	6.5	03	2	8
LIBERTY STAR	WCBP	6	37.1 N	23.5 W	12	12	M	42	5 NM	16	1022.0	20.0	24.0	5	14.5			
HUAL LISITA	LAXK2	6	57.1 N	13.6 W	18	28	M	39	5 NM		1001.0	9.5	12.0	10	26	29	14	28
HUAL LISITA	LAXK2	7	55.1 N	19.5 W	18	31	M	40	10 NM		1010.0	8.0	12.0	8	21	30	9	23
ITB BALTIMORE	WXKM	9	37.5 N	72.5 W	19	04		36	5 NM		1018.0			5	13	04	10	16.5
HUAL LISITA	LAXK2	10	49.5 N	39.1 W	00	30	M	42	10 NM		1016.5	13.0	15.0	6	13	30	9	14.5
ITB BALTIMORE	WXKM	10	38.0 N	72.8 W	00	05		35	5 NM		1018.4	15.6	18.9	5	13	02	10	16.5
ITB BALTIMORE	WXKM	10	39.0 N	73.5 W	12	04		35	5 NM	60	1017.0	7.8	12.8	3	10	04	6	16.5
TILLIE LYKES	WMLH	11	36.8 N	69.9 W	18	25	M	40	10 NM	02	1006.5	18.9		6	13	23	7	10
EVER GALLANT	BKJN	14	41.7 N	61.7 W	17	32	M	36	5 NM	80	1004.5	11.5	15.0	6	8	32	8	10
EVER GALLANT	BKJN	14	41.4 N	63.7 W	23	31	M	35	5 NM	03	1010.0	10.2	15.0	6	8	29	6	8
METTE MAERSK	OXKT2	16	56.6 N	27.6 W	18	10	M	36	5 NM		1004.0	8.0	8.6	10	16.5			
NOAA SHIP DELAWARE II	KNBD	17	42.4 N	70.5 W	03	33	M	36	5 NM		1015.5	4.5	9.6	4	5	34	4	6.5
OLGA TOPIC	A8EE	20	48.4 N	07.9 W	00	01		38	5 NM		1025.0	11.0	12.0	9	19.5			
ARGONAUT	KFDV	20	38.1 N	52.4 W	00	28		35	10 NM		1015.0	17.8	23.3	6	13	29	8	14.5
OLGA TOPIC	A8EE	22	43.1 N	22.5 W	06	20		38	2 NM		1014.0	18.0	18.0	8	10			
ARNOLD MAERSK	OZGI2	22	41.0 N	38.9 W	18	30		44	5 NM		1007.2	18.2		7	19.5	28	8	23
ARNOLD MAERSK	OZGI2	23	40.7 N	41.0 W	00	27		35	5 NM		1012.2	16.2		5	16.5	28	7	23
ARNOLD MAERSK	OZGI2	23	41.2 N	42.8 W	06	27		41	5 NM		1011.6	15.0		6	18			
GREEN WAVE	KRHL	23	48.4 N	07.0 W	18	19		35	5 NM		1014.0	10.6	12.0	4	8	22	8	16.5
OLGA TOPIC	A8EE	24	38.2 N	31.1 W	00	28		37	5 NM		1007.0	18.0	20.0	8	10			
GREEN WAVE	KRHL	24	47.6 N	08.3 W	00	19		35	5 NM		1007.0	12.8		4	6.5	23	6	16.5
OLGA TOPIC	A8EE	24	37.4 N	32.1 W	06	31		37	5 NM		1009.0	17.0	20.0	8	11.5			
GREEN WAVE	KRHL	25	44.9 N	12.3 W	06	24		40	5 NM		0998.9	13.3		5	6.5	23	10	19.5
ADABELLE LYKES	WPFZ	25	47.3 N	15.5 W	06	26		42	10 NM		0989.0	12.2	15.0	7	14.5	26	8	18
SEALAND VALUE	WPKB	25	36.9 N	27.3 W	06	28		35	5 NM	25	1005.8	17.8	17.8	5	10	28	6	8
GOLDEN ENDEAVOR	WDBU	26	31.7 N	26.0 W	06	36		35	10 NM		1036.3	19.4	20.0	5	5	33	7	13
PACIFIC DEC.																		
NEPTUNE AMBER	S6CY	1	35.3 N	177.3 E	00	29	M	40	1 NM	60	1009.0	15.0		3	6.5	29	10	16.5
BACTAZAR	3EEU6	1	49.5 N	153.5 W	12	12	M	40	5 NM		1011.3	6.0	7.0	5	10	11	6	8
ORCHID	3EKV5	1	54.4 N	174.9 W	12	09	M	42	2 NM	81	1001.0	4.0	3.0	3	5	09	3	5
ORCHID	3EKV5	1	54.4 N	177.6 W	18	11	M	44	1 NM	81	0990.0	5.0	3.0	3	5	11	3	5
SEALAND PRODUCER	WJBJ	2	38.0 N	151.8 W	06	20	M	36	2 NM	63	1018.0	15.6	13.9	5	8	12	6	16.5
M/V VERA ACORDE	3EAG4	2	39.8 N	173.6 E	12	10	M	40	.5 NM		0999.4	7.1	16.0	12	19.5	11	12	19.5
M/V VERA ACORDE	3EAG4	3	40.3 N	175.2 E	06	36	M	64	.25 NM		0978.5	8.0	16.0	13	44	36	14	44
M/V VERA ACORDE	3EAG4	3	40.2 N	175.7 E	12	34	M	60	.25 NM		0999.4	8.1	13.2	13	39	34	14	42.5
OCEAN SEL	3ETR3	3	43.2 N	146.0 E	12	17	M	38			1013.0	6.0	5.0	5	8	17	5	6.5
OCEAN SEL	3ETR3	3	42.2 N	144.0 E	18	25	M	38			1011.0	8.0	5.0	6	8	25	6	8
M/V VERA ACORDE	3EAG4	7	45.0 N	155.1 W	18	18	M	40	1 NM		1003.4	12.4	11.4	9	8	19	10	8
M/V VERA ACORDE	3EAG4	8	45.8 N	153.4 W	00	20	M	38	50 YD		0996.0	12.0	11.0	10	8	20	10	10
PACMERCHANT	5MCB	8	43.5 N	166.4 W	01	32	M	35	5 NM	02	1013.0	10.0	8.0	5	11.5	32	7	11.5
M/V VERA ACORDE	3EAG4	8	46.4 N	151.9 W	06	21	M	40	.5 NM		0988.4	13.2	11.2	9	10	21	12	11.5
SEALAND PRODUCER	WJBJ	8	32.5 N	123.7 W	06	02	M	35	10 NM		1017.0	13.3	12.2	4	13	32	6	10
M/V VERA ACORDE	3EAG4	8	47.0 N	150.2 W	12	29	M	45	2 NM		1004.0	7.0	1.1	8	11.5	29	10	10
M/V VERA ACORDE	3EAG4	8	47.3 N	148.6 W	18	29	M	40	2 NM		1014.0	6.2	10.4	8	16.5	29	14	16.5
EVER LAUREL	BKHH	9	44.8 N	166.3 W	00	23	M	38	10 NM	02	1024.5	12.0	9.0	8	10	22	8	11.5
MAERSK PINE	GKJJ	9	52.6 N	151.7 W	06	26		35	5 NM	83	1006.6	5.3		6	13	28	10	16.5
MAERSK PINE	GKJJ	9	52.5 N	149.3 W	12	24		38	5 NM	58	1003.5	7.0		6	13	25	10	16.5
SHIRAOI MARU	3ECM7	10	45.9 N	161.1 W	00	22	M	43	2 NM	12	1017.5	12.0	10.0	6	16.5	24	8	21
EVER LAUREL	BKHH	10	46.6 N	155.4 W	00	24	M	42	2 NM	10	1019.0	10.5	9.0	9	11.5	21	11	14.5
SEALAND PACIFIC	WSRL	10	44.9 N	178.9 E	18	36	M	35	2 NM		1005.8	8.9	6.7	4	14.5	36	6	16.5
EVER LAUREL	BKHH	11	47.3 N	144.9 W	00	26	M	37	1 NM		1018.0	11.0	9.0	9	11.5	21	14	16.5
EVER LAUREL	BKHH	12	47.2 N	134.2 W	00	26	M	38	5 NM	02	1014.5	12.0	9.5	8	10	24	13	14.5
SEALAND HAWAII	KIRF	19	38.3 N	163.7 E	03	20	M	46	1 NM	52	0999.9	17.8	17.2	6	14.5	17	9	21
OCEAN SEL	3ETR3	20	47.3 N	148.6 W	00	20	M	38	.5 NM	61	1007.2	11.0	9.0	8	11.5	20	9	14.5
OCEAN SEL	3ETR3	20	47.6 N	141.5 W	18	27	M	42	2 NM	50	1009.1	8.0	7.0	8	11.5	27	9	13
OCEAN SEL	3ETR3	21	47.7 N	139.0 W	00	26	M	38	2 NM	07	1000.0	9.0	7.0	8	11.5	26	9	13
SEALAND HAWAII	KIRF	22	37.1 N	168.9 W	00	25	M	36	10 NM		1012.5	16.7	15.0	7	10	30	10	18
ATLANTIC DEC.																		
NOSAC RANGER	WRYG	1	45.5 N	24.8 W	00	19		35	5 NM		1013.0	10.5		6	13	20	10	13
NOSAC RANGER	WRYG	1	46.1 N	22.4 W	06	19		35	5 NM		1018.0	14.5		6	13	19	10	14.5
GREEN RIDGE	WRYL	1	32.0 N	36.5 W	12	29		35	2 NM	62	1009.1	19.5		4	11.5			
GREEN RIDGE	WRYL	1	31.7 N	37.5 W	18	32		40	10 NM	02	1010.5	17.2		5	10	32	12	14.5
GREEN RIDGE	WRYL	2	31.6 N	38.8 W	00	34		40	5 NM	02	1013.0	18.0		6	14.5			
GREEN WAVE	KRHL	4	33.5 N	75.3 W	00	25		40	2 NM		1010.0	24.4		4	14.5			

October, November and December 1991

	RADIO	MAIL
WESTERN FUTURE	3	37
CHEVRON ANTWERP	36	39
DIRECT KOOKABURRA		67
EMARALD SEA		41
GREEN SASEBO	16	38
GREEN WAVE		35
HAWAIIAN EXPRESS	28	67
M/V BRAVADO	6	58
M/V HAJIN KAOHSIUNG	16	9
MORELAS	39	53
NO NAME	26	20
PRINCE OF OCEAN		48
SKANDERBOG		23
STRIDER ISIS	1	
USCGC JARVIS		20
VILIANT	19	62
WESTERN CRYSTAL	30	52
1ST LT ALEX BONNYMAN	6	
1ST LT JACK LUMMIS	70	
2ND LT. JOHN P. BOBO	2	
ACE ACCORD	32	12
ACONCAGUA	35	17
ACT 10	87	
ACT 4	97	
ACT 5	150	
ACT 6	194	
ACT 7	165	
ACT I	171	
ADABELLE LYKES	65	151
ADDIRIYAH	9	1
ADMIRAL WILLIAM M. CAL	38	
ADMIRALTY BAY	71	163
ADRIAN MAERSK	20	
ADRIANE-E	30	
ADVANTAGE	46	37
AGNES	72	31
AIDE	40	
AINO	98	
AL WATTYAH	9	15
ALASKA RAINBOW	55	103
ALBERT MAERSK	18	42
ALDEN W. CLAUSEN	18	41
ALEMANIA EXPRESS	57	
ALISON LYKES	17	
ALLIGATOR COLUMBUS	52	
ALLIGATOR EXCELLENCE	58	
ALLIGATOR FORTUNE	33	
ALLIGATOR HOPE	38	118
ALLIGATOR JOY	19	84
ALLIGATOR LIBERTY	35	
ALLIGATOR PRIDE	25	85
ALLIGATOR TRIUMPH	15	31
ALMERIA LYKES	46	23
ALPENA	78	65
ALPHA HELIX	150	164
ALTAMONTE	32	34
AMBASSADOR BRIDGE	46	13
AMERICA EXPRESS	47	
AMERICAN CONDOR	71	
AMERICAN CORMORANT	20	
AMERICAN EAGLE	20	
AMERICAN FALCON	80	19
AMERICAN HERITAGE	9	
AMERICAN KESTREL	1	35
AMERICAN REPUBLIC	52	54
AMERICAN TRADER	18	14
AMERICANA	33	69
AMERIGO VESPUCCI	14	1
AMOCO CAIRO	17	
ANASTASTS	5	
ANDERS MAERSK	59	182
ANGLO ORION	130	61
ANNA MAERSK	4	
ANTHONY RAINBOW	26	
ARABIAN SENATOR	63	
ARCO ALASKA	26	
ARCO ANCHORAGE	16	
ARCO CALIFORNIA	1	
ARCO FAIRBANKS	6	
ARCO INDEPENDENCE	43	38
ARCO JUNEAU	36	
ARCO PRUDHOE BAY	2	
ARCO SAG RIVER	25	
ARCO SPIRIT	9	
ARCO TEXAS	29	24
ARCTIC DISCOVERER		28
ARCTIC OCEAN	45	90
ARCTIC TOKYO	26	82
ARGONAUT	50	94
ARILD MAERSK	21	
ARMCO	91	69
ARNOLD MAERSK	11	21
ARTHUR M. ANDERSON	336	352
ARTHUR MAERSK	43	67
ASHLEY LYKES	35	27
ASIAN SENATOR	60	
ASPEN	33	37
ASTRO JYOJIN	70	128
ATIGUN PASS	5	22
ATLA	7	
ATLANTIC	72	
ATLANTIC CARTIER	81	
ATLANTIC COMPASS	73	
ATLANTIC CONVEYOR	88	
ATLANTIC OCEAN	123	90
ATLANTIC SENTRY	11	84
ATLANTIS II	31	
ATLAS HIGHWAY	17	
AUSTRAL LIGHTNING	22	35
AUSTRAL RAINBOW	42	55
AXEL MAERSK	45	109
B.T. ALASKA	60	179
BAAB ULLAH	22	
BACTAZAR	45	107
BALTIMORE TRADER	97	44
BAR' ZAN	58	
BARDU	2	
BAY BRIDGE	103	78
BEBEDOURO	25	
BELGIAN SENATOR	60	
BIBI	64	
BLUE HAWK	23	
BOGASARI LIMA	115	
BOHOL SAMPAGUITA	24	
BONN EXPRESS	64	
BRILLIANT ACE	73	
BROOKLYN BRIDGE	46	55
BROOKS RANGE	48	15
BUCKEYE	75	93
BUFFALO	37	26
BUNGA KANTAN	10	
BUNGA KENANGA	57	
BUNGA KESIDANG	8	
BURNS HARBOR	366	407
BUYER	26	
C.W. KITTO		104
CALCITE II	214	158
CALGA	1	
CANADIAN RAINBOW	78	38
CAPE ALAVA	6	
CAPE ANN	12	34
CAPE ARCHWAY	22	
CAPE BLANCO	81	
CAPE BOVER	61	70
CAPE BRETON	41	51
CAPE CARTHAGE	14	
CAPE CATOCHE	92	
CAPE CHARLES	13	
CAPE COD	12	
CAPE DECISION	12	14
CAPE DIAMOND	10	
CAPE DOMINGO	6	39
CAPE DOUGLAS	4	
CAPE EDMONT	67	
CAPE GIBSON	2	46
CAPE HENRY	46	
CAPE HORN	80	56
CAPE HUDSON	90	
CAPE INSCRIPTION	24	43
CAPE ISABEL	54	50
CAPE JUBY	62	19
CAPE LAMBERT	65	
CAPE NOME	5	
CARIBE 1		21
CARLA A. HILLS	44	47
CARMAN	27	
CARMEL	18	
CAROLINA	19	64
CARTAGENA	81	25
CASON J. CALLAWAY	141	110
CELEBRATION	29	
CENTURY HIGHWAY #2	218	55
CENTURY HIGHWAY NO. 5	202	
CGM ILE DE FRANCE	116	57
CGM LORRAINE	29	
CGM PASTEUR	55	
CGM PROVENCE	89	
CHABLIS	40	2
CHACO	1	
CHAITEN	27	
CHALLENGER	35	
CHARLES E. WILSON	238	191
CHARLESTON	56	28
CHARLOTTE LYKES	71	53
CHELSEA	8	6
CHEMICAL PIONEER	83	
CHERRY VALLEY	6	
CHESAPEAKE TRADER	35	
CHESNUT HILL	19	16
CHEVRON ANTWERP	86	49
CHEVRON ARIZONA	9	10
CHEVRON BURNABY	88	167
CHEVRON CALIFORNIA	148	151
CHEVRON COLORADO	34	57
CHEVRON COPENHAGEN		6
CHEVRON EDINBURGH	26	97
CHEVRON HORIZON		70
CHEVRON MISSISSIPPI	49	79
CHEVRON NAGASAKI		88
CHEVRON OREGON	53	58
CHEVRON PACIFIC	16	126
CHEVRON SKY		140
CHEVRON STAR		70
CHEVRON SUN		48
CHEVRON WASHINGTON	42	43
CHICKASAW	92	48
CHINA GLORY	67	
CHINA PRIDE	26	
CHIQUITA BOCAS	40	
CHO YANG SUCCESS	29	20
CLEMENT	82	
CLEMENTINA	16	
CLEVELAND	3	162
CO-OP EXPRESS III	51	
COAST RANGE	4	8
COASTAL CORPUS CHRISTI	59	2
COLIMA	17	91
COLUMBIA STAR	75	96
COLUMBINE	14	23
COLUMBUS AMERICA	162	
COLUMBUS AUSTRALIA	120	
COLUMBUS LOUISANA	88	
COLUMBUS NEW ZEALAND	57	
COLUMBUS OHIO	164	85
COLUMBUS OLIVOS	44	35
COLUMBUS ONTARIO	100	
COLUMBUS QUEENSLAND	65	
COLUMBUS VICTORIA	216	
COLUMBUS VIRGINIA	175	
COLUMBUS WELLINGTON	157	
COMPANION EXPRESS	61	
CONCERT EXPRESS	58	
CONSENSUS SEA	10	2
CONTIENTAL WING	100	109
CONTSHIP SPAIN	55	
CORAH ANN	25	19
CORNHUSKER STATE	91	
CORNUCOPIA	22	100
CORWITH CRAMER	77	53
COURTNEY BURTON	155	187
CPL. LOUIS J. HAUGE JR	24	4
CRISTOFORO COLOMBO	27	25
CSS HUDSON	108	
CYPRESS PASS	16	
CYPRESS TRAIL	23	
DAN MOORE	12	30
DEL MONTE HARVESTER	3	
DEL VALLE	19	
DELAWARE TRADER	34	152
DIAMOND STATE	1	20
DIANA	9	10
DON JORGE	8	14
DONAIRE		140
DSR OAKLAND	105	
DSR YOKOHAMA	130	
DUSSELDORF EXPRESS	67	
DYVI OCEANIC	5	
EASTERN GLORY	23	

October, November and December 1991

	RADIO	MAIL
EASTERN VENTURE	137	118
ECSTASY	84	38
EDEN	49	130
EDGAR B. SPEER	274	288
EDWARD L. RYERSON	53	18
EDWIN H. GOTT	429	420
EDYTH L.	60	34
ELIZABETH LYKES	42	
EMERALD SEA	35	69
ENDEAVOR	1	
ENGLISH STAR	50	
ENSOR	24	
EQUALITY STATE	40	62
ESSO PUERTO RICO	20	23
ETERNITY	20	
EUROPEAN SENATOR	38	
EVER GAINING	8	
EVER GALLANT	1	10
EVER GARDEN	4	
EVER GARLAND	5	
EVER GENTLE	2	
EVER GENTRY	1	
EVER GIANT	8	
EVER GIFTED	26	18
EVER GIVEN	6	
EVER GLAMOUR	6	
EVER GLORY	4	22
EVER GLOWING	13	
EVER GOING	10	
EVER GOODS	9	
EVER GRACE	6	
EVER GRAND	2	
EVER GREET	5	
EVER GROWTH	4	
EVER GUARD	19	
EVER GUEST	11	
EVER LAUREL	16	22
EVER LEVEL	8	7
EVER LINKING	22	
EVER LIVING	7	
EVER LOADING	2	
EVER VITAL	8	40
EXPORT FREEDOM	53	61
EXPORT PATRIOT	53	128
EXXON BENICIA	41	
EXXON LONG BEACH	1	7
EXXON MEDITERRANEAN	17	16
EXXON NEW ORLEANS	4	
EXXON PHILADELPHIA	31	
EXXON SAN FRANCISCO	31	32
FAIRLIFT	63	
FALSTAFF	11	
FARNELLA	101	
FAUST	44	43
FERNCROFT	87	97
FESTIVALE	73	88
FETISH	121	117
FLICKERTAIL STATE	57	20
FLORIDA RAINBOW	50	58
FORTALEZA	71	128
FRANCES HAMMER	30	27
FRANCES L.	72	99
FRED R. WHITE JR	24	41
FUJI	34	86
GALVESTON BAY	70	73
GEM STATE	41	25
GEMINI	42	77
GENEVIEVE LYKES	5	28
GEORGE A. SLOAN	188	151
GEORGE A. STINSON	72	86
GEORGE WASHINGTON BRID	179	59
GEORGIA RAINBOW II	50	107
GERMAN SENATOR	122	
GERONIMO	11	
GLACIER BAY	15	60
GLOBAL FAME	3	
GLOBAL LINK	14	
GLORIOUS SPICA	9	
GOLD BOND CONVEYOR	26	
GOLDEN ENDEAVOR	29	53
GOLDEN GATE	13	40
GOLDEN GATE BRIDGE	170	41
GOLDEN HAWK	69	105
GOLDEN MONARCH	4	
GOPHER STATE	30	
GREAT LAND	265	175
GREAT RIVER	22	102
GREEN BAY	87	108
GREEN ELLIOTT		2
GREEN ISLAND	44	53
GREEN KOBE	12	42
GREEN LAKE	83	114
GREEN MAYA	1	
GREEN RIDGE	9	26
GREEN SAIKAI	18	81
GREEN SUMA	21	85
GREEN VALLEY	12	
GREEN WAVE	23	64
GUANAJUATO	183	
GUAYAMA	9	17
GULF SENTRY	14	
GULF SPEED	16	
GULF SPIRIT	54	
HAKONE MARU	57	
HANEI SKY	4	103
HANEI SUN	35	
HANJIN BUSAN	30	26
HANJIN CHUNGMU	11	
HANJIN FELIXSTOWE	10	
HANJIN HAMBURG	2	
HANJIN HONG KONG	10	
HANJIN KEELUNG	6	
HANJIN KOBE	21	
HANJIN LE HAVRE	17	
HANJIN LONG BEACH	8	
HANJIN MASAN	7	
HANJIN NEW YORK	25	
HANJIN OAKLAND	10	
HANJIN POHANG	50	16
HANJIN ROTTERDAM	3	
HANJIN SAVANNAH	8	
HANJIN SEATTLE	8	
HANJIN SEOUL	19	17
HANJIN TONGHAE	45	15
HANJIN VANCOUVER	8	
HANJIN YOKOHAMA	17	
HANNOVER	6	
HANNOVERLAND	58	
HANSA LUBECK	88	
HANSA VISBY	42	
HAWAIIAN RAINBOW	14	33
HEIDELBERG EXPRESS	51	
HELM STAR	11	
HENRY HUDSON BRIDGE	178	
HERACLITUS	5	
HERBERT C. JACKSON	67	61
HERMENIA	17	42
HESIOD	2	
HIRA II	38	
HOEGH CAIRN	8	
HOEGH CLIPPER	19	17
HOEGH DENE	5	
HOEGH DRAKE	8	19
HOEGH DYKE	19	
HOEGH MASCOT	1	
HOEGH MIRANDA	35	54
HOLIDAY	12	
HONOLULU	41	
HOWELL LYKES	36	95
HUAL ANGELITA	24	56
HUAL LISITA	107	134
HUMACAO	60	42
HYUNDAI COMMANDER	22	
HYUNDAI CONTINENTAL	38	
HYUNDAI EXPLORER	10	
HYUNDAI INNOVATOR	35	
HYUNDAI NO 102	7	
HYUNDAI PIONEER	17	
INDEPENDENT SPIRIT	105	
INDIAN OCEAN	32	32
INFANTA	51	
ISLAND PRINCESS	148	
ITAITE	6	
ITB BALTIMORE	66	51
ITB NEW YORK	56	43
IVER EXPLORER	90	
IVER EXPRESS	13	
J.A.W. INGLEHART	92	128
J.L. MAUTHE	84	78
JACKSONVILLE	67	97
JALISCO	36	44
JAMES LYKES	17	11
JAPAN ALLIANCE	77	33
JAPAN APOLLO	100	92
JAPAN RAINBOW 2	15	21
JAPAN SENATOR	61	
JEAN LYKES	60	
JO BIRK	54	
JO CLIPPER	111	
JO LONN	152	
JO ROGN	37	
JOANN M	24	85
JOHN G. MUNSON	222	160
JOHN LYKES	26	43
JOHN YOUNG		186
JOSEPH H. FRANTZ	262	291
JOSEPH LYKES	6	
JUBILEE	2	
JULIUS HAMMER	66	50
JUPITER	2	68
KAIMOKU	34	166
KAINULA	51	176
KATHLEEN PEARCY	30	
KATHLEEN PEARY		24
KAUAI	84	186
KAYE E. BARKER	88	99
KEBAN		5
KEE LUNG	12	41
KEISHO MARU	29	
KENAI	52	25
KENNETH E. HILL	15	75
KENNETH T. DERR		65
KENTUCKY HIGHWAY	12	
KEYSTONE CANYON	91	57
KEYSTONER	40	54
KISO	63	
KITTANING	34	
KOKUA	167	185
KOLN ATLANTIC	89	
KUROBE	1	
LAKE	7	
LASH ATLANTICO	38	
LAUST MAERSK	53	127
LAWRENCE H. GIANELLA	17	
LEE A. TREGURTHA	58	40
LEONARD J. COWLEY	118	
LERMA	185	
LESLIE LYKES	45	32
LETITIA LYKES	24	36
LIBERTY STAR	51	66
LIBERTY SUN	66	108
LIBERTY WAVE	71	3
LILAS	19	50
LIRCAY	34	
LNG AQUARIUS	51	73
LNG CAPRICORN	11	7
LNG LEO	39	
LNG LIBRA	3	11
LNG TAURUS	14	66
LNG VIRGO	29	26
LONG LINES	95	30
LOUIS MAERSK	40	33
LOUISE LYKES	69	71
LT. ODYSSEY	17	
LURLINE	54	189
LYRA	27	40
M V HAMBURG STAR		43
M V POLYDEFKIS	78	82
M. P. GRACE	12	
M.V. CALIFORNIA HERMES	46	68
M.V. CHIQUITA CINCINNA	40	54
M.V. EVER GATHER	28	24
M.V. OOCL EVNVOY	58	65
M/V VERA ACORDE	48	131
MAASSLOT	131	
MACKINAC BRIDGE	188	44
MADISON MAERSK	20	89
MAERSK COMMANDER	120	
MAERSK CONSTELLATION	1	15
MAERSK PINE	146	146
MAERSK TACOMA	16	
MAGALLANES	12	26
MAGIC	96	1
MAGLEBY MAERSK	41	
MAJESTIC MAERSK	20	31
MALLORY LYKES	48	
MANHATTAN BRIDGE	123	
MANUKAI	61	197

October, November and December 1991

	RADIO	MAIL
MANULANI	67	168
MARATHA MAJESTY	3	
MARCHEN MAERSK	12	25
MAREN MAERSK	16	71
MARGARET LYKES	47	60
MARGRETHE MAERSK	19	22
MARIE MAERSK	26	105
MARIF	33	15
MARINE RELIANCE	42	97
MARIT MAERSK	33	98
MARJORIE LYKES	72	48
MARLIN		117
MASON LYKES	54	100
MATHILDE MAERSK	37	52
MATSONIA	61	187
MAUI	154	136
MAURICE EWING	37	76
MAYAGUEZ	30	32
MC-KINNEY MAERSK	28	10
MEDALLION	61	60
MEDUSA CHALLENGER	35	33
MELBOURNE HIGHWAY	7	
MENINA BARBARA	1	
MERCANDIAN CONTINENT	45	16
MERCANDIAN SUN II	69	21
MERCURY ACE	77	
MERIDA	57	60
MERKUR AMERICA	27	
MERKUR PORTUGAL	82	
MESABI MINER	51	65
METTE MAERSK	32	68
MICHIGAN HIGHWAY	37	
MICRONESIAN COMMERCE	44	23
MICRONESIAN INDEPENDEN	28	
MIDDLETOWN	64	77
MINDORO SAMPAGUITA	5	
MINERVA	1	
MING ENERGY	2	
MING MOON	11	23
MING PLEASURE	9	
MING SUN	18	37
MING UNIVERSE	4	
MITLA	1	92
MOANA PACIFIC	85	18
MOANA WAVE	120	
MOKU PAHU	37	
MONTE CERVANTES	4	
MONTERREY	80	35
MORELOS	22	
MORMACSKY	16	
MORMACSTAR	76	7
MORMACSUN	65	33
MYRON C. TAYLOR	119	126
NANCY LYKES	6	
NARA	34	66
NATIONAL DIGNITY	31	106
NATIONAL HONOR	23	84
NATIONAL PRIDE	38	39
NAVIOS UNIQUE	1	
NCC ARAR	12	9
NECHES	14	
NEDLLOYD BAHRAIN	11	
NEDLLOYD BALTIMORE	133	
NEDLLOYD BANGKOK	100	
NEDLLOYD BARCELONA	75	
NEDLLOYD CLARENCE	99	
NEDLLOYD HOLLAND	55	38
NEDLLOYD HUDSON	56	63
NEDLLOYD MADRAS	142	
NEDLLOYD MANILA	129	
NEDLLOYD ROTTERDAM	74	
NEDLLOYD ROUEN	109	
NEDLLOYD VAN CLOON	25	
NEPTUNE ACE	13	
NEPTUNE AMBER	42	95
NEPTUNE CORAL	31	
NEPTUNE CRYSTAL	47	
NEPTUNE DIAMOND	122	
NEPTUNE GARNET	13	
NEPTUNE JADE	13	
NEPTUNE PEARL	30	
NEPTUNE TOURMALINE	2	
NEW HORIZON	76	130
NEW YORK SENATOR	78	
NEWARK BAY	52	62
NIPPON HIGHWAY	47	
NOAA SHIP ALBATROSS IV	13	16
NOAA SHIP CHAPMAN	94	100
NOAA SHIP DELAWARE II	302	253
NOAA SHIP DISCOVERER O	396	334
NOAA SHIP FERREL	68	
NOAA SHIP HECK 591	1	
NOAA SHIP M. BALDRIDGE	9	
NOAA SHIP MCARTHUR	268	209
NOAA SHIP MILLER FREEM	156	185
NOAA SHIP MT MITCHELL	28	
NOAA SHIP OREGON II	213	258
NOAA SHIP RAINIER	8	67
NOAA SHIP SURVEYOR	90	
NOAA SHIP T. CROMWELL	55	376
NOAA SHIP WHITING	229	264
NOBEL STAR	89	46
NORTHERN LIGHT	18	41
NOSAC EXPLORER	21	58
NOSAC EXPRESS	55	49
NOSAC RANGER	40	93
NOSAC TAKAYAMA	121	100
NUEVO SAN JUAN	56	208
NURNBERG ATLANTIC	113	
OAXACA	75	
OCEAN ASPIRATION	23	64
OCEAN BRIDGE	17	
OCEAN CHEER	34	
OCEAN COMMANDER #1	9	
OCEAN CONQUEROR	78	
OCEAN HIGHWAY	37	
OCEAN ISLAND	21	
OCEAN LILY	33	
OCEAN OPAL	40	51
OCEAN SEL	7	124
OCEAN SPIRIT	41	
OCEAN VICTOR	24	23
OLEANDER	125	125
OLGA TOPIC		47
OLGLEBAY NORTON	34	50
OMI CHARGER		2
OMI MISSOURI	22	18
OMI WABASH	44	
OOCL BRAVERY	127	
OOCL CHARGER	29	
OOCL EDUCATOR	44	25
OOCL EXECUTIVE	52	64
OOCL EXPLORER	41	16
OOCL FAIR	42	49
OOCL FAITH	36	
OOCL FORTUNE	34	
OOCL FRIENDSHIP	28	27
ORANGE BLOSSOM	36	
ORANGE STAR	130	104
ORCHID	31	172
OREGON RAINBOW II	37	67
ORIENTAL FREEDOM	79	
ORION HIGHWAY	41	12
OVERSEAS BOSTON	47	117
OVERSEAS JOYCE	22	144
OVERSEAS JUNEAU		88
OVERSEAS MARILYN	29	51
OVERSEAS NEW YORK	3	
OVERSEAS PHILADELPHIA	1	15
OVERSEAS VALDEZ	10	
PACASIA	24	
PACBARON	24	
PACDUCHESS	107	60
PACDUKE	5	
PACGLORY	16	
PACIFIC EMERALD	29	88
PACIFIC PRINCESS	29	
PACKING	42	
PACMERCHANT	23	30
PACNOBLE	11	
PACOCEAN	26	18
PACPRINCE	23	
PACPRINCESS	61	
PACQUEEN	18	
PACSEA	21	
PACSTAR	15	
PACSUN	10	
PACTRADER	11	
PAGA		41
PAPAGO	41	75
PAPYRUS	31	74
PARIS SENATOR	2	
PATRIOT	13	
PAUL H. TOWNSEND	8	
PAUL R. TREGURTHA	298	327
PAUL THAYER	84	110
PECOS	36	
PEGGY DOW	142	
PELANDER	47	41
PENNSYLVANIA TRADER	48	14
PERMEKE	121	
PETER W. ANDERSON	41	
PETROBULK PROGRESS	46	
PFC DEWAYNE T. WILLIAM	10	
PFC EUGENE A. OBREGON	13	55
PFC JAMES ANDERSON JR	9	14
PFC WILLIAM B. BAUGH	4	
PHAROS	68	
PHILIP R. CLARKE	239	260
PINE FOREST	12	51
PIONEERS		7
POLAR ALASKA	12	103
POLYNESIA	263	181
PONCE	16	45
POTOMAC TRADER	12	6
PRESIDENT ADAMS	104	182
PRESIDENT ARTHUR	19	71
PRESIDENT BUCHANAN	37	
PRESIDENT EISENHOWER	163	105
PRESIDENT F. ROOSEVELT	28	108
PRESIDENT GARFIELD	9	12
PRESIDENT GRANT	46	105
PRESIDENT HARDING	80	19
PRESIDENT HARRISON	130	
PRESIDENT HOOVER	34	104
PRESIDENT JACKSON	16	48
PRESIDENT JEFFERSON	2	5
PRESIDENT KENNEDY	88	61
PRESIDENT LINCOLN	145	122
PRESIDENT MADISON	11	159
PRESIDENT MONROE	69	56
PRESIDENT PIERCE	40	98
PRESIDENT POLK	180	159
PRESIDENT TRUMAN	83	109
PRESIDENT TYLER	83	176
PRESIDENT WASHINGTON	223	22
PRESQUE ISLE	206	234
PRINCE OF TOKYO	119	183
PRINCE OF TOKYO 2	86	165
PRINCE WILLIAM SOUND	19	105
PROSPERO	33	108
PUERTO CORTES	1	
PURITAN	171	
PVT FRANKLIN J. PHILLI	10	
QUALITY OF LIFE	29	
QUEEN ELIZABETH 2	88	
R V JOHN W VICKERS	124	90
R.V. LAKE GAURDIAN	23	29
RAINBOW BRIDGE	65	
RAINBOW HOPE	29	51
RALEIGH BAY	51	53
RANA M	37	50
RANGER	43	
RANI PADMINI	1	
RECIFE	116	
RED ARROW	3	
REFORM	6	37
RESERVE	121	162
RESOLUTE	42	73
RICHARD G MATTIESEN	58	
RICHARD REISS	28	21
RIJEKA EXPRESS	3	
RIO FRIO	49	
RIO NEGRO II	31	
RISING STAR	22	
ROBERT E. LEE	18	32
ROGER BLOUGH	153	264
ROSEBANK	64	
ROSETTA	55	59
ROSINA TOPIC	15	
ROTTERDAM	59	
ROVER	1	7
ROYAL PRINCESS	55	
RUBIN DOGA	38	
RUBIN OCEAN	17	39
RUTH LYKES	43	11
S.T. CRAPO	202	212
SALINAS	19	81

October, November and December 1991

	RADIO	MAIL
SAM HOUSTON	28	29
SAMU	32	48
SAMUEL L. COBB	53	
SAN MARTIN	37	
SAN MATEO VICTORY	15	
SAN NICOLAS	49	
SAN PEDRO	44	94
SANKO PIONEER	23	
SANKO PRELUDE	32	
SANSINENA II	28	97
SANTA ANA	1	
SANTA MARTA	16	37
SANTOS	50	
SAPAI	15	37
SATURN DIAMOND	88	
SAVANNAH	20	
SCAN	14	53
SCARAB	121	101
SCHACKENBORG	7	27
SEA BELLS	33	103
SEA BREEZE II	14	9
SEA COMMERCE	70	
SEA FAN	93	149
SEA FORTUNE	16	94
SEA FOX	43	
SEA LIGHT	33	29
SEA LION	298	163
SEA MERCHANT	339	
SEA TRADE	122	
SEA WOLF	142	93
SEALAND ACHIEVER	221	
SEALAND ANCHORAGE	54	114
SEALAND ATLANTIC	59	1
SEALAND CHALLENGER	55	
SEALAND CONSUMER	83	206
SEALAND CRUSADER	87	77
SEALAND DEFENDER	138	79
SEALAND DISCOVERY	30	35
SEALAND ENDURANCE	75	
SEALAND ENTERPRISE	215	244
SEALAND EXPEDITION	28	24
SEALAND EXPLORER	70	126
SEALAND EXPRESS	117	186
SEALAND HAWAII	79	278
SEALAND INDEPENDENCE	11	22
SEALAND INNOVATOR	108	140
SEALAND INTEGRITY	61	124
SEALAND KODIAK	27	68
SEALAND LIBERATOR	86	119
SEALAND MARINER	38	76
SEALAND NAVIGATOR	219	143
SEALAND PACIFIC	221	227
SEALAND PATRIOT	62	129
SEALAND PERFORMANCE	114	104
SEALAND PRODUCER	82	242
SEALAND QUALITY	70	59
SEALAND RELIANCE	81	108
SEALAND SPIRIT	59	130
SEALAND TACOMA	34	100
SEALAND TRADER	189	179
SEALAND VALUE	56	94
SEALAND VOYAGER	109	89
SEDCO/BP 471	240	159
SEMINOLE	91	119
SENATOR	145	72
SGT WILLIAM A BUTTON	4	
SGT. METEJ KOCAK	41	84
SHELDON LYKES	83	60
SHELLY BAY	37	68
SHIN BEISHU MARU	73	
SHINKASHU MARU	82	
SHIRAOI MARU	100	47
SIERRA MADRE	32	52
SILVER CLIPPER	42	20
SITHEA	11	82
SKANDERBORG	57	
SKAUBORD	40	40
SKAUBRYN	66	
SKAUGRAN	113	124
SKODSBORG	47	67
SOLAR WING	87	144
SONBAI	9	
SONORA	66	76
SOREN TOUBRO	7	
SOUTHLAND STAR	142	
SPIRIT OF TEXAS	27	59
SPRING BEAR	45	

	RADIO	MAIL
SPRING BEE	22	
SPRING VEGA	1	
S.T. CRAPO	113	150
ST. CLAIR	261	310
STAR EAGLE	47	45
STAR EVVIVA	11	
STAR FLORIDA	47	
STAR FRASER	96	
STAR FUJI	8	
STAR GEIRANGER	16	4
STAR GRAN	43	64
STAR GRINDANGER	13	
STAR HONG KONG	172	
STAR MARLINN	20	
STAR MERCHANT		87
STAR MINERVA	18	68
STAR STRONEN	63	37
STAR WILMINGTON	8	
STELLA LYKES	30	
STELLAR VENUS	33	
STEWART J. CORT	206	149
STONEWALL JACKSON	12	32
STUTTGART EXPRESS	81	
SUE LYKES	33	39
SUGAR ISLANDER	40	63
SUNBELT DIXIE	2	
SUNRISE RUBY	62	235
SWAN LAKE	49	
SWIFTNES	11	
SYOSSET	15	
TABASCO	102	120
TAI CHUNG	37	
TAI SHAN	75	
TAI SHING	33	27
TAMPA	6	
TAMPA BAY	73	122
TERNOZA	25	
TEXACO GEORGIA	2	
TEXAS TRADER	22	
THOMAS WASHINGTON	77	58
TILLIE LYKES	43	89
TOHZAN	20	14
TOLUCA	5	62
TONCI TOPIC	34	60
TONSINA	3	3
TOWER BRIDGE	156	
TRANSWORLD BRIDGE	60	80
TRITON	218	247
TUG MICHIGAN	261	210
TULSIDAS	4	
TYSON LYKES	52	44
UCHOA	107	101
ULTRAMAR	45	
ULTRASEA		50
UNAMONTE	23	
UNIVERSE	9	
URTE	189	
USCGC ACACIA (WLB406)	4	
USCGC ACTIVE WMEC 618	34	
USCGC ACUSHNET WMEC 16	31	
USCGC ALERT (WMEC 630)	10	
USCGC BASSWOOD (WLB 38	84	
USCGC BEAR (WEMC 901)	38	
USCGC BRAMBLE (WLB 392	33	
USCGC CAMPBELL	16	
USCGC CHASE (WHEC 718)	59	
USCGC CITRUS (WMEC 300	35	
USCGC COURAGEOUS	12	39
USCGC DEPENDABLE	5	
USCGC DURABLE (WMEC 62	9	
USCGC ESCAPE (WMEC 6)	50	62
USCGC FIREBUSH WLB 393	11	
USCGC FORWARD	22	
USCGC HAMILTON WHEC 71	5	32
USCGC HARRIET LANE	45	
USCGC IRONWOOD (WLB 29	64	61
USCGC LAUREL (WLB 291)	6	
USCGC MACKINAW	5	
USCGC MALLOW (WLB 396)	29	
USCGC MELLON (WHEC 717	14	
USCGC MUNRO	4	
USCGC NEAH BAY	2	5
USCGC NORTHLAND WMEC 9	124	10
USCGC PLANETREE	33	
USCGC POLAR STAR WAGB	168	
USCGC RUSH	102	53
USCGC SEDGE (WLB 402)	3	10

	RADIO	MAIL
USCGC SENECA	23	9
USCGC SPENCER	36	
USCGC STEADFAST WMEC 6	41	
USCGC STORIS (WMEC 38)	20	
USCGC SUNDEW (WLB 404)	4	17
USCGC SWEETBRIER WLB 4	70	
USCGC TAHOMA	43	
USCGC TAMAROA (WMEC 16	14	
USCGC VALIANT (WMEC 62	20	
USCGC VIGILANT WMEC 61	19	
USCGC YOCONA (WMEC 168		62
USNS APACHE (T-ATF 172	36	7
USNS BARTLETT(T-AGOR 1	4	
USNS BELLATRIX		9
USNS CAPELLA	1	
USNS CHAUVENET TAGS 29	41	
USNS COMET	30	38
USNS DE STEIGUER	9	32
USNS GUS W. DARNELL	19	
USNS JOHN LENTHAL		19
USNS MERCURY	51	121
USNS METEOR	60	77
USNS MOHAWK (T-ATF 170	51	
USNS NARRAGANSETT	90	69
USNS NAVAJO	38	51
USNS POTOMAC	43	
USNS POWHATAN TATF 166	40	39
USNS REGULUS	2	
USNS RIGEL (T-AF 58)		59
USNS SEALIFT ARABIAN S	1	
USNS SEALIFT ARCTIC	24	
USNS SEALIFT ATLANTIC	109	126
USNS SEALIFT CARIBBEAN	54	
USNS SEALIFT CHINA SEA	62	
USNS SEALIFT IND'N OCE	41	35
USNS SEALIFT MEDITERRA	47	23
USNS SILAS BENT T-AGS	30	
USNS VANGUARD TAG 194	28	
USNS WILKES T-AGS-33	64	
VAN TRADER	39	42
VIKING ACE	31	165
VINE	130	
WASHINGTON HIGHWAY	45	
WASHINGTON RAINBOW #2	26	120
WELLINGTON STAR	143	
WEST MOOR	106	
WESTWARD	40	63
WESTWARD VENTURE	11	28
WESTWOOD ANETTE	49	42
WESTWOOD BELINDA	16	27
WESTWOOD CLEO	130	145
WESTWOOD JAGO	114	47
WESTWOOD MARIANNE	9	118
WHITE ROSE	11	
WHITING SEA	9	
WILFRED SYKES	88	129
WILLIAM E. MUSSMAN	37	221
WILLIAM R. ROESCH	38	46
WINDWARD SENTRY	3	60
WINTER MOON	82	
WOLVERINE	9	8
WORLD WING #2	34	11
YAMATAKA MARU	46	
YANKEE CLIPPER	96	
YOKOHAMA	6	
YOUNG SPROUT	34	51
ZEELANDIA	52	
ZEUS	10	
ZIM AMERICA	40	
ZIM CALIFORNIA	45	
ZIM CANADA	51	
ZIM HONGKONG	28	
ZIM HOUSTON	42	
ZIM IBERIA	37	
ZIM KEELUNG	53	
ZIM KINGSTON III	286	
ZIM MARSEILLES	53	
ZIM MIAMI	19	
ZIM SAVANNAH	39	

SUMMARY: GRAND TOTAL VIA RADIO 52596
GRAND TOTAL VIA MAIL 41434
TOTAL UNIQUE OBS 74510
TOTAL DUPLICATES 19520 (26.2%)
UNIQUE RADIO OBS.33076 (44.4%)
UNIQUE MAIL OBS. 21914 (29.4%)

October, November and December 1991

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
A8VI	75	75	0	PACDUCHESS
BNPC	2	2	0	***
BNTA	78	78	0	***
BNTB	4	4	0	***
BOAB	10	10	0	TAI HE
CBVM	26	26	0	VINA DEL MAR
CGBS	11	0	11	PARIZEAU
CGBV	138	0	138	DAWSON
CGDG	11	0	11	HUDSON
CGDV	245	245	0	W. TEMPLEMAN
CG2683	75	75	0	ALFRED NEEDLER
CG2965	1	1	0	RICKER
CXFN	1	1	0	PRESIDENTE RIVERA
C6HL8	105	105	0	ACT 10
C6JY6	79	79	0	ACT 4
C6JZ2	57	57	0	ACT 3
C6JZ3	23	23	0	ACT 6
DAKE	147	147	0	KOELN ATLANTIC
DA9100	244	244	0	PLATFORM NORDSEE
DBFP	8	8	0	WALTHER HERWIG
DBLK	72	72	0	POLAT STERN
DGLM	35	35	0	MONTE ROSA
DGVK	61	61	0	COLUMBUS VICTORIA
DGZV	78	78	0	COLUMBUS VIRGINIA
DHCW	87	87	0	COLUMBUS WELLINGTON
DHOU	27	27	0	PURITAN
DIDA	38	38	0	ARIANA
DLEZ	32	32	0	YANKEE CLIPPER
D5BC	69	69	0	SEDCO/BP471
D5NZ	195	195	0	POLYNESIA
ELBX3	4	4	0	PACKING
ELED8	33	33	0	PACPRINCESS
ELEH4	3	3	0	C R POINTE NOIRE
ELHL6	62	62	0	COLUMBUS OHIO
EREA	2	2	0	MUSSON
EREC	85	5	80	PRILIV
EREI	96	7	89	OKEAN
ERET	81	77	4	GEORGE OUSHAKOV
FAQV	3	3	0	BALNY
FNCZ	79	79	0	DELMAS SURCOUF
FNED	39	39	0	***
FNGB	78	78	0	MARION DUFRESNE
FNGS	77	77	0	LA FAYETTE
FNJT	33	33	0	KORRIGAN
FNOM	43	43	0	ANGO
FNPA	4	4	0	RONSARD
FNQB	58	58	0	ILE MAURICE
FNQD	26	26	0	ILE EDLA REUION
FNQM	2	2	0	VILLE DE MARSEILLE
FNXW	7	7	0	***
FNZO	106	106	0	RABELAIS
FNZQ	9	9	0	RIMBAUD
FPYO	7	7	0	CAP SAINT PAUL
FQND	2	2	0	***
GACA	92	92	0	CUMULUS
GPHH	31	31	0	FARNELLA
GQEK	51	51	0	FORTHBANK
GXDE	10	10	0	SCYLLA
GYRW	36	36	0	ENCOUNTER BAY
GYSA	36	36	0	FLINDERS BAY
GYSE	45	45	0	NEDLLOYD TASMAN
HPAN	35	35	0	MICRONESIAN COMMERCE
HPEW	122	122	0	PACIFIC ISLANDER
H8CB	15	15	0	TILLY
H9BQ	14	14	0	MICRONESIAN INDEPENDENCE
JBOA	3	3	0	KEIFU MARU
JCCX	93	93	0	CHOFU MARU
JCOD	77	77	0	SHOYO
JDRD	69	69	0	SHOYO MARU
JDVE	102	102	0	WAKATAKE MARU
JDWX	77	77	0	KOFU MARU
JFDG	54	54	0	SHUMPU MARU
JFPQ	56	56	0	***
JGDW	25	25	0	KEITEN MARU
JGZK	95	95	0	RYOFU MARU
JITV	74	74	0	WELLINGTON MARU
JNSR	44	44	0	MUTSU
JNZL	11	11	0	***
JPVB	20	20	0	SEIFU MARU
JRBM	9	9	0	***
JSVY	4	4	0	SHIRASE
J8FO	97	97	0	ROSEBANK
KGJB	35	35	0	SEALAND DEFENDER
KGWU	8	8	0	TH. WASHINGTON
KIRH	36	36	0	SEA-LAND TRADER
KNBD	2	2	0	DELAWARE II
KNFG	24	24	0	SEA WOLF
KRGB	106	106	0	SEA-LAND ENTERPRISE
LADB2	49	49	0	SHAUGRAN
LADC2	20	20	0	SKAUBORD
LAJV4	38	38	0	SKAUBRYN
MKUE3	4	4	0	***
NAEH	2	2	0	BERKELEY
NAVOCE	169	169	0	U.S. NAVAL OCEANOGRAPHIC
NBMO	59	59	0	MISSOURI
NBTM	17	17	0	POLAR STAR
NIKA	20	20	0	SEALIFT ATLANTIC
NLPM	61	61	0	CHASE
NMEL	1	1	0	MELLON
NRUO	92	92	0	POLAR SEA
NWQU	1	1	0	TRIPOLI
OWUO6	64	64	0	MOANA PACIFIC COBENHAVN
PGDI	141	141	0	NEDLLOYD MANILA
PGDY	64	64	0	NEDLLOYD MADRAS
PGEC	9	9	0	NEDLLOYD VAN NOORT
PJJU	141	141	0	OLEANDER
SHIP	821	794	27	***
S6FK	98	98	0	SWAN REEFER
TFEA	8	8	0	BJARNI SAEMUNDSSON
TWR3	2	2	0	***
UFJN	68	0	68	VILNYUS
UFYN	114	0	114	KAPITAN SHAYTANOV
UUPB	3	0	3	AKADEMIK N. SHOKALSKIY
UVMJ	3	3	0	VSEVOLOD BERYOZKIN
UZFA	1	0	1	***
VC9450	244	244	0	GADUS ATLANTICA
VJBQ	47	47	0	ANRO AUSTRALIA
VJDI	39	39	0	IRON NEWCASTLE
VJDP	94	94	0	IRON PACIFIC
VKCN	4	4	0	CANBERRA
VKCV	19	19	0	DERWENT
VKDA	35	35	0	DARWIN
VKLA	31	31	0	ADELAIDE
VKLB	17	17	0	HOBART
VKLC	18	18	0	BRISBANE
VKMS	2	2	0	COOK
VKPT	26	26	0	PERTH
VLNB	4	4	0	TORRENS
VXN8	920	920	0	AIRCRAFT
V2PM	169	169	0	WEST MOOR
WCGN	23	23	0	CHEVRON CALIFORNIA
WLDZ	23	23	0	MAURICE EWING
WMVF	11	11	0	ALBATROSS IV
WPGK	72	72	0	NAVIGATOR
WPKD	116	116	0	SEA-LAND ACHIEVER
WRBA	3	3	0	PACMISRANFAC HAWAREA
WRBB	3	3	0	***
WSRL	25	25	0	SEA-LAND PACIFIC
WTDF	7	7	0	T. CROMWELL
WTDM	47	43	4	M.FREEMAN
WTDO	3	0	3	OREGON II
WTEA	131	82	49	DISCOVERER
WTEC	2	2	0	JOHN VICKERS
WTEG	2	2	0	MOUNT MITCHELL
WTEJ	23	23	0	MCARTHUR
WTES	58	53	5	SURVEYOR
WUS9293	52	52	0	MOANA WAVE
WXBR	32	32	0	CHEVRON MISSISSIPPI
YDLR	18	18	0	BOGASARI LIMA
Y3CH	12	0	12	PROF. ALBRECHT PENCK
Y3CW	12	0	12	A. V. HUMBOLDT
ZCKP	64	64	0	STAR HONG KONG
ZDAZ	71	71	0	***
ZDBE9	91	91	0	VOYAGER
ZMCR	5	5	0	CANTERBURY
3EET4	9	9	0	SEAS EIFFEL
7JDU	38	38	0	NATSUSHIMA
7JOB	16	16	0	SHIN KASHU MARU
7KDD	4	4	0	YOKO MARU
9VBZ	23	23	0	MAHSURI

October, November and December 1991

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
9VUU	25	25	0	ANRO ASIA
9VVB	64	64	0	GOLDENSARI INDAH
9VWM	29	29	0	***
21002	297	297	0	BUOY
21004	382	382	0	BUOY
22001	383	383	0	BUOY
31316	2	2	0	BUOY
31317	1	1	0	BUOY
32315	39	39	0	BUOY
32316	6	6	0	BUOY
32317	25	25	0	BUOY
32318	21	21	0	BUOY
43001	4	4	0	BUOY
51004	1	1	0	BUOY
51006	19	19	0	BUOY
51007	17	17	0	BUOY
51008	24	24	0	BUOY
51009	25	25	0	BUOY
51010	33	33	0	BUOY
51011	1	1	0	BUOY

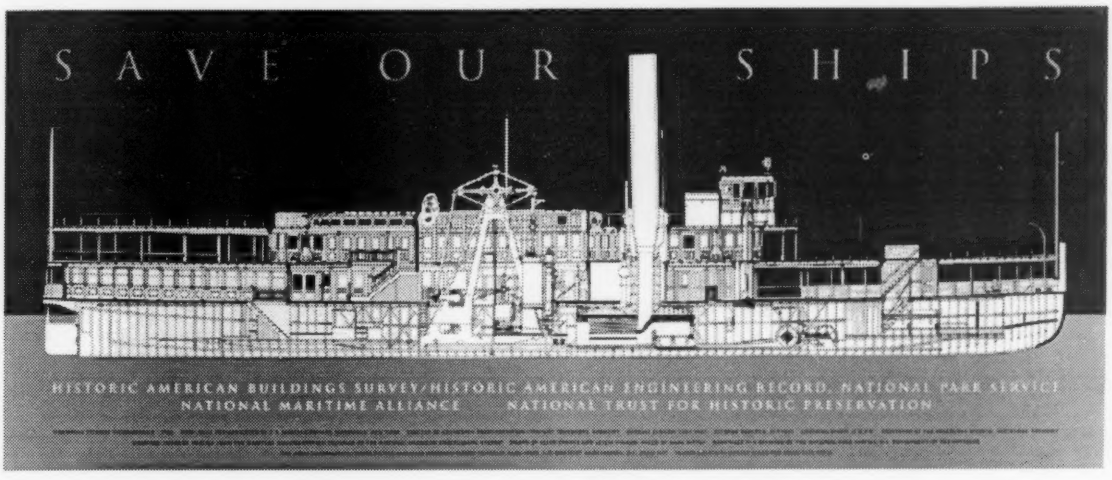
CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
51014	26	26	0	BUOY
51017	2	2	0	BUOY
51018	4	4	0	BUOY
51019	5	5	0	BUOY
51020	6	6	0	BUOY
51022	3	3	0	BUOY
51023	6	6	0	BUOY
52001	4	4	0	BUOY
52002	26	26	0	BUOY
52003	3	3	0	BUOY
52004	19	19	0	BUOY
52006	22	22	0	BUOY
52007	3	3	0	BUOY
52011	4	4	0	BUOY
52012	3	3	0	BUOY
52302	5	5	0	BUOY

TOTAL BATHYS RECEIVED 10224
TOTAL TESACS RECEIVED 631
TOTAL REPORTS RECEIVED 10855

Save Our Ships Poster

The overall state of preservation of historic vessels is by no means the only challenge facing the maritime heritage community in America. But it is clearly among the most visible. As a group, large vessels are more at risk than any other class of historic resources. In order to draw attention to the plight of America's historic vessels, the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Division of the National Park Service, with the cooperation of the National Maritime Alliance and National Trust, has produced a handsome poster with the message Save Our Ships. The poster's image is a HABS/HAER measured drawing of the Lake Champlain paddle steamer Ticonderoga, a designated National Trust Historic Landmark. The black and white inboard profile is printed on a background of blue and green, on heavy coated stock. Individual copies are available for $10 each postpaid and shipped in a heavy tube. Quantities are available wholesale. For more information or to order write:

Maritime Office, National Trust
1785 Massachusetts Av., NW
Washington, DC 20036



October, November and December 1991

Wave observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688-2838 for more details.

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
32302	18.0S	085.1W	0732	18.1	18.5	2.0	3.6	16/06	13.6	SE	24.7	16/03	1017.6
33301	56.3S	027.6W	0321	-4.2									990.1
41001	34.9N	073.0W	0222	21.3	23.9	3.5	8.1	31/00	17.1	NE	31.9	29/03	1019.4
41002	32.3N	075.2W	0742	23.7	25.4	2.1	7.9	31/09	13.2	E	27.2	29/03	1017.0
41008	30.7N	081.1W	0743	22.7	23.8	1.2	3.3	02/13	10.9	NE	31.5	02/13	1017.9
41009	28.5N	080.2W	1486	25.4	27.1	1.7	5.6	31/18	12.1	NE	24.5	24/03	1016.7
41010	28.9N	078.5W	1487	25.3	27.1	1.9	5.3	31/16	13.1	NE	27.2	01/16	1016.3
41017	35.4N	075.1W	0545	20.8	24.1	1.4	3.4	17/08	12.5	N	30.1	17/08	1016.0
42001	25.9N	089.7W	0744	25.8	27.5	1.1	4.0	07/05	11.4	NE	29.1	06/23	1015.0
42002	25.9N	093.6W	0742	26.1	27.0	1.0	4.2	07/13	12.0	NE	31.3	07/03	1015.3
42003	25.9N	085.9W	0742	25.9	28.2	1.2	3.0	07/03	12.8	E	26.0	06/23	1015.6
42007	30.1N	088.8W	0692	22.5	23.8				12.0	E	32.1	06/15	
42019	27.9N	095.0W	0741	25.3	26.8	1.2	4.2	06/20	11.7	SE	27.6	31/23	1015.3
42020	27.0N	096.5W	0145	26.5	27.8	1.3	3.8	07/00	11.6	NE	24.5	06/21	1014.5
42025	24.9N	080.4W	0744	26.8	27.9	0.5	1.8	24/10					
44007	43.5N	070.1W	0742	11.0	11.5	1.1	6.9	31/02	13.9	SW	34.4	30/13	1019.2
44008	40.5N	069.4W	0741	14.3	14.7	1.9	9.6	30/23	13.6	N	53.0	31/01	1019.3
44009	38.5N	074.7W	0742	16.3	18.5	1.3	4.8	31/12	13.0	N	42.4	17/10	1019.2
44011	41.1N	066.6W	0741	14.1	14.8	2.2	12.0	30/16	11.9	SE	48.8	30/15	1018.9
44012	38.8N	074.6W	0741	16.1	18.1	1.2	4.7	31/02	13.3	S	44.3	17/15	1019.0
44013	42.4N	070.8W	0744	12.4	12.3	1.0	9.1	31/02	13.6	SW	44.1	31/02	1019.0
44014	36.6N	074.8W	0742	17.9	19.0	1.7	8.1	31/03	11.6	N	35.4	17/11	1018.8
44025	40.3N	073.2W	0727	15.7	17.0	1.4	5.0	31/10	12.2	S	33.0	31/11	1019.0
44026	36.0N	073.5W	0527	21.7	26.2	1.6	3.7	15/19	13.2	SE	29.9	15/16	1016.9
45001	48.1N	087.8W	0647	5.2	6.1	1.0	3.7	05/17					1011.7
45002	45.3N	086.4W	0742	9.0	11.1	1.1	2.2	23/09					1014.6
45003	45.3N	082.7W	0744	7.9	7.4	1.1	2.7	06/00	14.1	S	29.9	05/07	1015.4
45004	47.5N	086.5W	0744	5.5	5.9	1.1	3.3	06/04					1013.7
45006	47.3N	089.9W	0658	5.9	6.2	0.9	2.5	06/01	11.9	W	25.8	17/23	1013.6
45007	42.8N	087.1W	0541	11.5	13.3	1.1	2.8	05/19	14.1	SW	25.6	04/23	1014.8
45008	44.3N	082.4W	0744	10.4	11.7	1.3	3.2	05/22	13.4	S	27.5	05/21	1016.4
46001	56.3N	148.3W	0743	7.7	8.9	2.7	5.9	09/00	15.4	W	34.4	09/03	1011.1
46002	42.5N	130.4W	0743	16.2	17.4	2.3	5.5	26/09	13.3	N	32.8	26/06	1021.3
46003	51.9N	155.9W	0743	8.4	8.8	2.9	7.8	16/18	15.8	SW	32.4	12/15	1011.9
46005	46.1N	131.0W	0739	14.7	15.9	2.3	6.8	22/13	12.2	NW	30.7	22/11	1020.8
46011	34.9N	120.9W	0235	14.3	15.7	1.6	2.4	04/23	7.7	NW	20.8	01/23	1014.7
46012	37.4N	122.7W	0742	13.6	14.1	1.7	4.5	27/09	10.0	NW	28.2	27/12	1015.0
46013	38.2N	123.3W	0742	13.2	13.8	1.8	4.6	27/01	10.8	NW	29.7	29/22	1015.4
46014	39.2N	124.0W	0018	12.4	13.7	1.3	1.6	01/00	5.4	N	10.6	01/14	1020.8
46022	40.8N	124.5W	0740	11.9	11.6	2.1	4.3	26/20	8.1	N	26.0	29/20	1016.6
46023	34.3N	120.7W	0743	14.9	15.7	1.9	5.1	27/16	13.1	NW	27.4	27/13	1014.0
46025	33.8N	119.1W	0742	17.3	18.5	0.9	2.7	27/16	6.7	NW	27.0	27/15	1013.4
46026	37.8N	122.7W	0742	13.1	14.0	1.3	3.6	27/02	9.7	NW	30.3	27/01	1015.2
46027	41.8N	124.4W	0295	12.1	11.6	1.7	3.3	03/01	7.3	N	27.6	03/01	1016.0
46028	35.8N	121.9W	0743	14.7	15.6	2.0	5.0	27/14	11.1	NW	26.9	28/03	1015.3
46029	46.2N	124.2W	0533	11.4	11.7	2.0	3.9	27/12	9.1	N	22.7	16/10	1018.8
46030	40.4N	124.5W	0179	12.6		1.6	3.0	03/19	13.3	N	25.5	05/21	1015.6
46035	57.0N	177.7W	0738	6.1	7.2	2.5	6.8	15/15	15.1	SW	36.1	15/08	1007.8
46040	44.8N	124.3W	0741	11.3	10.3	2.0	4.0	23/02	9.4	N	26.0	29/09	1018.2
46041	47.4N	124.5W	0743	10.3	11.2	1.7	4.4	16/19	7.1	NW	26.2	16/13	1018.7
46042	36.8N	122.4W	0742	13.5	15.3	1.9	4.8	27/05	10.8	NW	26.2	27/13	1015.3
46045	33.8N	118.5W	0740	17.3	18.2	0.7	2.5	27/14	4.6	SW	23.1	28/06	1013.4
46A35	57.0N	177.7W	0390	6.0	6.6	4.5	6.3	15/12	16.7	SW	34.6	25/10	1007.2
51001	23.4N	162.3W	0354	26.2	27.6	1.9	3.1	10/06	8.4	E	18.8	02/13	1014.7
51002	17.2N	157.8W	0740	26.2		1.7	2.6	14/02	12.2	E	21.3	04/04	1012.2
51003	19.3N	160.8W	0743	26.7	27.8	1.8	3.4	13/16	9.7	E	18.1	04/10	1011.9
51004	17.4N	152.5W	0691	25.9	26.8	1.8	2.6	10/06	11.6	NE	20.7	06/21	1012.0
91222	18.1N	145.8E	0729	27.3									
91251	11.4N	162.4E	0742	27.6					9.7	E	23.4	25/14	1008.5
91343	7.6N	155.2E	0737	27.9					4.2	SW	17.8	23/23	1006.9
91353	6.2N	160.7E	0738	27.6					4.8	W	20.5	01/20	1008.9
91365	8.9N	165.8E	0740	27.8					5.9	E	22.3	30/00	1009.0
91377	6.1N	172.1E	0742	28.2					4.7	NW	27.8	27/22	1008.3
ALSN6	40.5N	073.8W	0743	14.3	16.3	1.0	3.1	17/21	14.8	SW	36.6	31/10	1019.8
BURL1	28.9N	089.4W	0744	23.3					13.7	NE	34.4	06/17	1016.5
BUSL1	27.9N	090.9W	0045		27.2				9.9	SE	15.6	30/05	1016.4
BUZM3	41.4N	071.0W	0743	13.8					15.7	SE	46.4	31/03	1019.1
CARO3	43.3N	124.4W	0743	11.2					9.4	NE	34.9	25/20	1017.2
CHLV2	36.9N	075.7W	0739	17.6	19.9	1.2	4.0	31/05	13.4	N	45.0	17/13	1019.8
CLKN7	34.6N	076.5W	0736	19.2					10.7	NE	27.7	29/00	1018.5
CSBF1	29.7N	085.4W	0741	21.7					6.2	NE	13.3	06/19	1017.6
DBLN6	42.5N	079.4W	0743	12.9					10.5	E	39.9	05/22	1017.8

October, November and December 1991

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
DESW1	47.7N	124.5W	0743	10.2					7.8	NW	34.3	16/13	1019.2
DISW3	47.1N	090.7W	0743	6.2					13.1	SW	37.1	17/22	1013.6
DPIA1	30.3N	088.1W	0742	21.7	22.7				11.4	E	35.2	06/17	1017.9
DSLN7	35.2N	075.3W	0705	20.5		1.8	6.8	31/10	16.1	N	38.7	29/05	1018.7
FBIS1	32.7N	079.9W	0743	20.0					9.7	NE	28.9	29/06	1018.6
FFIA2	57.3N	133.6W	0740	6.9					13.6	SE	44.1	21/18	1016.7
FPSN7	33.5N	077.6W	0742	22.1	25.0				15.7	NE	33.6	29/00	1018.4
FWYF1	25.6N	080.1W	0742	26.4	27.5				12.7	E	28.8	30/00	1014.9
GBCL1	27.8N	093.1W	0735	24.7	26.9	1.0	3.7	07/05	12.4	NE	33.8	06/16	1015.9
GDIL1	29.3N	090.0W	0744	22.9	23.8				11.1	NE	30.2	06/16	1016.7
GLLN6	43.9N	076.5W	0743	12.0					13.9	S	31.6	07/03	1017.9
IOSN3	43.0N	070.6W	0743	11.8					16.0	S	41.2	31/01	1019.8
KOSP2	5.4N	163.0E	0696	26.8					5.1	E	19.6	31/05	1008.5
LKWF1	26.6N	080.0W	0739	26.0	27.4				11.5	E	29.7	08/08	1015.1
LNEL1	28.2N	089.1W	0717	27.6									1017.0
MDRM1	44.0N	068.1W	0744	10.2					17.6	S	46.0	30/21	1019.8
MISM1	43.8N	068.9W	0705	10.7					17.8	S	49.3	30/22	1019.7
MLRF1	25.0N	080.4W	0743	26.6	27.8				11.4	E	26.2	30/03	1014.3
MPCL1	29.4N	088.6W	0735	23.4	25.4	1.3	3.5	06/20	15.1	E	27.8	30/10	1017.3
NWPO3	44.6N	124.1W	0737	10.8					7.3	N	22.0	13/00	1019.7
PILM4	48.2N	088.4W	0743	4.8					15.0	NW	39.4	29/06	1013.8
PTAC1	39.0N	123.7W	0744	12.3					9.0	N	27.1	21/20	1015.8
PTAT2	27.8N	097.1W	0741	24.2	25.7				12.6	SE	26.2	06/18	1014.9
PTGC1	34.6N	120.7W	0631	14.2					13.6	N	39.3	27/13	1014.1
ROAM4	47.9N	089.3W	0743	4.9	6.5				15.2	NW	35.9	30/01	1015.2
SANF1	24.5N	081.9W	0222	25.9	27.1				15.6	E	26.4	30/04	1014.6
SAUF1	29.9N	081.3W	0742	22.6	24.1				10.5	NE	28.2	07/16	1017.1
SBIO1	41.6N	082.8W	0744	13.1					12.5	S	35.0	05/19	1017.3
SGNW3	43.8N	087.7W	0743	12.1					12.7	S	30.8	05/02	1015.2
SISW1	48.3N	122.9W	0684	9.9					6.2	W	36.0	21/13	1019.0
SMKF1	24.6N	081.1W	0744	26.6	28.0				12.8	E	30.1	26/00	1014.7
SPGF1	26.7N	079.0W	0744	25.9	27.9				8.8	E	22.9	29/19	1014.9
SRST2	29.7N	094.1W	0734	22.1					9.3	SE	26.5	30/16	1017.4
STDM4	47.2N	087.2W	0743	6.2					17.0	NW	40.0	05/13	1020.0
SVLS1	32.0N	080.7W	0742	20.8		1.0	2.5	02/19	13.4	NE	33.5	29/09	1018.4
TPLM2	38.9N	076.4W	0744	15.1	17.7				10.5	S	27.7	17/15	1019.9
TTIW1	48.4N	124.7W	0725	9.5					12.2	NE	41.0	16/13	1019.9
VENF1	27.1N	082.5W	0743	23.7	25.9				7.8	NE	20.4	16/16	1015.6
NOVEMBER	1991												
32302	18.0S	085.1W	0713	18.3	19.1	2.0	4.4	06/14	12.5	SE	21.8	06/08	1016.9
33301	56.3S	027.6W	0285	-1.6									994.8
41001	34.9N	073.0W	0720	19.1	22.8	2.1	6.4	01/01	13.3	S	30.1	01/00	1019.8
41002	32.3N	075.2W	0240	21.1	24.6	1.8	5.0	01/00	11.6	S	23.3	09/09	1019.9
41008	30.7N	081.1W	0716	17.0	19.5	1.1	2.9	09/14	10.7	N	24.3	09/12	1021.2
41009	28.5N	080.2W	1438	21.9	25.0	1.5	4.6	01/00	12.9	E	28.2	09/08	1020.3
41010	28.9N	078.5W	1436	22.6	25.5	1.6	5.1	01/00	13.6	E	36.3	09/12	1019.7
42001	25.9N	089.7W	0718	21.9	25.9	1.4	3.4	09/08	13.8	NE	29.0	08/23	1019.5
42002	25.9N	093.6W	0717	21.5	24.8	1.4	4.4	08/19	15.6	SE	34.2	20/12	1020.0
42003	25.9N	085.9W	0716	22.6	26.9	1.3	3.1	09/04	14.4	N	28.0	09/03	1019.6
42007	30.1N	088.8W	0465	14.6	19.7				12.5	N	29.7	04/08	
42019	27.9N	095.0W	0717	19.5	24.1	1.5	4.5	08/10	15.3	SE	30.7	08/06	1020.2
42025	24.9N	080.4W	0718	24.0	26.3	0.7	1.8	19/10					
44004	38.5N	070.7W	0341	15.7	19.5	1.8	4.7	17/10	17.1	W	31.1	23/07	1021.9
44007	43.5N	070.1W	0720	5.9	8.8	0.9	3.1	01/00	13.3	N	31.3	11/16	1018.6
44008	40.5N	069.4W	0714	10.3	11.4	1.8	4.4	17/08	15.3	W	33.8	17/04	1018.9
44009	38.5N	074.7W	0717	10.7	13.3	1.2	4.9	10/14	15.3	N	35.4	10/13	1020.4
44011	41.1N	066.6W	0719	10.3	11.1	2.1	5.1	17/18	15.1	W	32.4	17/12	1017.8
44012	38.8N	074.6W	0718	10.2	13.0	1.1	4.2	10/13	15.5	S	36.9	10/15	1020.1
44013	42.4N	070.8W	0719	7.2	9.5	0.8	4.0	11/16	13.8	NW	38.9	11/16	1018.5
44014	36.6N	074.8W	0717	13.1	14.8	1.5	5.4	09/23	12.8	N	33.8	09/23	1013.6
44025	40.3N	073.2W	0662	10.5	13.2	1.3	4.1	10/17	13.8	SW	29.1	10/22	1019.6
45002	45.3N	086.4W	0720	2.2	8.1	1.4	5.9	02/07					1015.9
45003	45.3N	082.7W	0235	1.0	7.7	1.7	4.3	06/08	20.2	SW	33.4	06/06	1019.1
45004	47.5N	086.5W	0698	0.6	4.9	1.5	4.6	03/08					1014.7
45008	44.3N	082.4W	0213	0.8	8.1	1.7	3.6	03/10	17.0	SW	29.2	02/17	1020.7
46001	56.3N	148.3W	0719	6.4	7.6	3.3	6.8	23/03	16.0	E	42.4	30/22	995.2
46002	42.5N	130.4W	0305	16.1	15.9	2.6	5.3	13/14	11.5	SW	18.7	05/02	1020.4
46003	51.9N	155.9W	0720	6.1	7.4	4.0	9.0	19/18	19.4	SW	38.9	19/16	996.8
46005	46.1N	131.0W	0718	13.2	14.1	3.8	9.3	16/22	16.6	S	37.1	17/05	1016.2
46012	37.4N	122.7W	0718	12.2	12.1	2.4	5.9	29/14	12.0	NW	37.9	29/14	1020.4
46013	38.2N	123.3W	0717	11.8	11.8	2.5	5.4	18/05	13.0	NW	33.2	29/15	1020.6
46022	40.8N	124.5W	0719	10.5	10.8	2.8	6.7	18/04	9.1	N	35.6	17/04	1022.1
46023	34.3N	120.7W	0716	14.2	14.3	2.7	8.0	30/00	13.7	NW	32.1	29/22	1017.4
46025	33.8N	119.1W	0714	15.8	16.2	1.2	3.3	14/11	6.8	NW	27.6	30/02	1016.5
46026	37.8N	122.7W	0718	11.9	12.0	1.9	4.0	19/02	11.0	NW	35.4	29/13	1020.1
46028	35.8N	121.9W	0640	13.7	14.1	2.6	5.4	19/08	12.4	NW	28.5	14/22	1019.4
46029	46.2N	124.2W	0713	10.4	10.8	2.9	8.3	17/04	12.7	S	36.9	16/17	1020.3
46035	57.0N	177.7W	0718	3.5	5.8	3.3	8.8	13/11	16.8	NE	34.6	13/07	999.6
46040	44.8N	124.3W	0719	10.7	10.7	3.0	9.1	17/05	11.5	S	38.1	17/01	1020.5
46041	47.4N	124.5W	0709	9.4	9.9	2.9	8.4	17/10	12.4	SE	34.6	19/19	1018.7
46042	36.8N	122.4W	0717	12.3		2.7	6.4	29/16	13.1	NW	35.4	29/16	1019.8
46045	33.8N	118.5W	0712	15.7	16.0	0.9	2.9	14/22	5.3	SW	25.1	30/01	1016.5
46050	44.6N	124.5W	0340	10.9	11.7	3.8	9.1	17/04	15.3	S	40.6	17/01	1020.5
51002	17.2N	157.8W	0720	26.0		2.5	3.7	08/22	16.4	E	25.8	13/13	1013.1
51003	19.3N	160.8W	0719	26.2	27.2	2.4	4.0	23/00	12.7	E	27.6	13/21	1013.2

October, November and December 1991

Wave observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688-2838 for more details.

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
51004	17.4N	152.5W	0239	25.8	26.4	2.7	4.0	23/15	16.3	E	26.3	29/00	1013.3
91222	18.1N	145.8E	0623	27.3									
91251	11.4N	162.4E	0531	27.5					12.9	NE	32.3	30/03	1009.0
91343	7.6N	155.2E	0714	27.8					6.0	NE	28.7	25/22	1008.3
91353	6.2N	160.7E	0716	27.4					6.2	NE	45.4	24/19	1008.7
91365	8.9N	165.8E	0720	27.6					12.9	NE	63.6	29/11	1008.7
91377	6.1N	172.1E	0719	27.5					7.1	E	21.9	17/21	1007.5
ALSN6	40.5N	073.8W	0691	8.9	12.3	0.8	2.5	10/08	14.9	NW	36.4	17/00	1020.6
BURL1	28.9N	089.4W	0706	15.6					14.0	N	31.1	08/10	1021.4
BUSL1	27.9N	090.9W	0293		25.6				11.6	N	27.8	18/13	1021.5
BUZM3	41.4N	071.0W	0719	8.3					16.7	SW	39.6	11/13	1018.7
CARO3	43.3N	124.4W	0717	10.8					9.5	S	42.2	17/02	1020.7
CHLV2	36.9N	075.7W	0720	11.8	13.6	1.1	4.6	10/03	15.4	N	46.2	09/22	1019.9
CLKN7	34.6N	076.5W	0716	13.7					10.0	N	36.8	10/01	1020.8
CSBF1	29.7N	085.4W	0716	14.8					6.5	N	19.1	01/14	1021.7
DBLN6	42.5N	079.4W	0720	5.2					12.8	SW	38.8	25/17	1019.4
DESW1	47.7N	124.5W	0717	9.0					14.1	SE	50.1	19/19	1018.8
DISW3	47.1N	090.7W	0718	-1.9					15.4	SW	38.7	01/18	1014.9
DPIA1	30.3N	088.1W	0718	13.3	14.8				11.6	N	27.1	04/10	1022.4
DSLN7	35.2N	075.3W	0694	15.6		1.6	6.6	09/23	16.5	N	45.9	09/18	1020.8
FBIS1	32.7N	079.9W	0720	13.3					8.2	NE	23.1	17/23	1021.5
FFIA2	57.3N	133.6W	0717	5.1					15.1	SE	42.3	15/04	1005.9
FPSN7	33.5N	077.6W	0719	17.2	21.6				15.3	N	48.5	09/21	1021.0
FWYF1	25.6N	080.1W	0719	23.5	25.5				14.7	E	27.9	29/02	1018.4
GBCL1	27.8N	093.1W	0709	18.7	24.3	1.2	3.3	08/13	15.4	SE	36.7	20/08	1020.9
GDIL1	29.3N	090.0W	0715	14.7	15.4				10.9	N	27.6	24/06	1021.8
GLLN6	43.9N	076.5W	0720	4.7					14.5	W	40.4	25/10	1019.3
IOSN3	43.0N	070.6W	0719	6.6					14.7	N	43.7	11/17	1019.3
KOSP2	5.4N	163.0E	0712	26.9					7.8	N	33.4	24/10	1007.9
MDRM1	44.0N	068.1W	0718	6.0					17.8	NW	42.0	11/12	1018.2
MISM1	43.8N	068.9W	0633	6.1					17.8	NW	45.2	11/18	1018.5
MLRF1	25.0N	080.4W	0717	23.6	25.8				13.6	E	24.7	29/13	1017.8
MPCL1	29.4N	088.6W	0707	17.1	22.5	1.2	2.3	04/13	13.1	N	32.8	24/06	1022.0
NWPO3	44.6N	124.1W	0716	9.8					9.9	E	51.4	17/02	1020.6
PILM4	48.2N	088.4W	0719	-1.4					16.9	NW	43.9	02/20	1014.3
PTAC1	39.0N	123.7W	0719	10.5					10.3	N	34.1	29/18	1021.3
PTAT2	27.8N	097.1W	0717	16.4	18.3				12.5	SE	27.7	03/10	1020.1
PTGC1	34.6N	120.7W	0718	14.0					13.7	N	40.2	30/00	1017.6
ROAM4	47.9N	089.3W	0718	-1.9	4.5				18.4	SW	45.8	02/17	1015.3
SANF1	24.5N	081.9W	0711	23.4	26.0				14.0	NE	24.6	26/12	1017.7
SAUF1	29.9N	081.3W	0718	16.4	19.6				9.8	NW	28.2	09/04	1020.7
SBIO1	41.6N	082.8W	0720	4.1					14.6	SW	36.0	24/19	1020.2
SGNW3	43.8N	087.7W	0719	0.6					13.0	S	36.2	01/23	1017.3
SISW1	48.3N	122.9W	0718	8.4					12.3	SE	51.1	16/16	1018.3
SMKF1	24.6N	081.1W	0716	23.3	25.7				15.1	NE	25.6	26/21	1018.1
SPGF1	26.7N	079.0W	0717	22.8	25.8				9.5	E	25.8	09/14	1018.5
SRST2	29.7N	094.1W	0718	13.1					9.7	SE	23.0	26/21	1022.9
STDM4	47.2N	087.2W	0717	0.3					18.8	S	45.0	30/14	1015.6
SVLS1	32.0N	080.7W	0710	14.8		0.9	2.3	09/12	12.7	N	30.6	09/10	1021.5
TPLM2	38.9N	076.4W	0717	9.0	11.1				11.8	S	28.0	10/13	1021.1
TTIW1	48.4N	124.7W	0716	8.8					15.9	E	49.3	19/17	1018.3
VENF1	27.1N	082.5W	0717	18.6	20.8				8.7	NE	27.0	24/17	1019.6
WPOW1	47.7N	122.4W	0714	9.2					9.9	S	39.6	17/07	1019.2
DECEMBER	1991												
32302	18.0S	085.1W	0741	19.7	20.2	1.5	2.6	12/18	10.2	SE	18.7	12/14	1015.7
33301	56.3S	027.6W	0329	-1.9									996.3
41001	34.9N	073.0W	0742	17.0	22.5	2.3	6.4	19/16	15.7	NW	37.1	21/20	1020.7
41002	32.3N	075.2W	0248	19.2	23.0	1.9	5.5	20/03	13.4	SW	27.3	04/06	1021.7
41008	30.7N	081.1W	0742	15.8	17.0	1.1	2.7	19/13	10.5	NE	25.3	19/11	1022.7
41009	28.5N	080.2W	1482	21.6	23.7	1.3	3.7	20/03	11.1	E	26.4	19/21	1022.2
41010	28.9N	078.5W	1482	21.7	24.3	1.6	4.5	20/10	13.5	SE	29.3	19/20	1021.7
42001	25.9N	089.7W	0742	22.2	24.5	1.5	4.5	20/13	13.9	NE	26.6	20/13	1020.2
42002	25.9N	093.6W	0743	22.1	23.2	1.5	3.8	20/14	15.3	SE	31.3	20/09	1020.0
42003	25.9N	085.9W	0743	22.7	26.3	1.4	4.9	20/10	14.2	E	28.0	04/14	1021.0
42007	30.1N	088.8W	0407	14.8	16.2				11.9	E	29.3	20/05	
42019	27.9N	095.0W	0744	19.6	22.4	1.6	4.5	20/13	13.7	SE	21.4	03/21	1020.2
42020	27.0N	096.5W	0655	20.3	22.4	1.7	4.6	20/07	14.0	SE	27.6	14/18	1020.0
42025	24.9N	080.4W	0743	23.4	25.2	0.7	2.4	20/12					
44004	38.5N	070.7W	0744	11.1	15.6	2.5	7.1	15/12	16.4	NW	36.3	15/05	1018.8
44007	43.5N	070.1W	0737	0.1	6.7	0.9	3.4	03/23	14.3	W	34.2	15/12	1017.2
44008	40.5N	069.4W	0743	6.2	8.6	2.1	5.6	30/18	17.7	NW	39.8	15/08	1018.3
44009	38.5N	074.7W	0743	7.7	10.6	1.1	2.6	17/23	16.2	NW	39.2	15/02	1020.6

October, November and December 1991

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
44011	41.1N	066.6W	0743	5.7	8.0	2.6	7.0	30/20	16.9	NW	34.4	17/04	1016.7
44012	38.8N	074.6W	0743	6.9	9.6	1.0	2.7	15/02	16.3	W	41.8	15/02	1020.3
44013	42.4N	070.8W	0743	2.4	7.0	0.7	3.7	30/15	16.2	NW	38.7	15/10	1017.1
44014	36.6N	074.8W	0743	11.4	14.4	1.6	3.5	19/12	15.4	SW	34.0	10/08	
44025	40.3N	073.2W	0695	6.8	9.9	1.3	4.2	15/03	15.4	W	35.2	15/04	1019.5
45002	45.3N	086.4W	0743	-0.8	6.0	1.1	4.2	07/04					1018.2
46001	56.3N	148.3W	0735	3.6	5.6	4.0	9.4	01/04	18.3	W	37.9	06/10	992.0
46003	51.9N	155.9W	0740	4.1	5.5	4.5	9.1	31/23	19.5	SW	39.2	31/19	995.7
46005	46.1N	131.0W	0741	10.9	11.9	4.2	8.4	20/20	16.3	S	35.0	20/17	1014.1
46012	37.4N	122.7W	0741	11.7	11.8	2.4	4.8	08/17	10.3	NW	34.2	29/05	1017.9
46013	38.2N	123.3W	0744	10.5	11.3	2.6	5.1	08/09	12.3	E	31.1	27/14	1018.0
46014	39.2N	124.0W	0312	10.9	11.7	3.1	5.4	28/12	11.4	SE	32.6	27/20	1015.7
46022	40.8N	124.5W	0739	9.7	9.9	3.0	5.9	08/14	9.8	N	28.0	26/18	1018.6
46023	34.3N	120.7W	0741	13.6	14.0	2.6	5.4	30/05	10.6	NW	30.5	27/23	1017.0
46025	33.8N	119.1W	0738	14.0	14.5	1.1	3.1	29/00	7.0	E	28.6	19/14	1017.1
46026	37.8N	122.7W	0738	10.6	10.9	1.9	4.0	28/00	11.5	NE	33.6	28/10	1017.9
46027	41.8N	124.4W	0450	9.3	9.4	2.7	4.9	25/12	7.8	SE	25.1	28/01	1016.2
46029	46.2N	124.2W	0743	9.3	10.0	3.1	6.2	13/01	11.9	E	30.4	05/20	1018.1
46030	40.4N	124.5W	0323	10.2	10.1	2.7	4.9	25/21	10.1	S	33.6	27/17	1018.0
46035	57.0N	177.7W	0738	-0.6	3.7	4.0	10.5	22/14	19.6	N	38.2	20/22	993.1
46040	44.8N	124.3W	0737	9.5		3.3	6.3	13/01	10.4	S	31.9	05/19	1018.1
46041	47.4N	124.5W	0735	8.6	9.3	3.2	7.1	12/21	12.6	SE	29.3	12/18	1016.6
46042	36.8N	122.4W	0735	11.8		2.8	5.1	28/17	10.9	NW	31.7	29/04	1017.6
46045	33.8N	118.5W	0742	13.8	14.5	0.9	2.6	19/17	5.2	E	27.4	19/18	1017.3
46047	32.7N	119.6W	0653	14.3	15.0	2.4	5.2	30/09	9.5	NW	33.4	19/17	1016.8
46048	32.9N	117.9W	0628	14.7	15.6	1.1	3.4	19/16	7.4	NW	31.5	19/15	1016.6
46050	44.6N	124.5W	0738	9.9	10.3	3.3	6.6	08/08	10.9	S	31.9	05/20	1017.5
51001	23.4N	162.3W	0477	23.3	25.2	3.2	7.0	20/06	15.4	E	29.3	14/04	1017.7
51002	17.2N	157.8W	0742	24.9		3.0	5.7	21/00	18.0	E	28.1	27/21	1013.8
51003	19.3N	160.8W	0389	25.4	26.5	3.0	5.7	20/15	15.1	E	25.5	11/18	1013.8
51004	17.4N	152.5W	0248	24.6	25.5	3.0	4.7	27/12	17.2	E	25.0	27/09	1014.0
52009	13.7N	144.7E	0309	26.8	26.7	1.9	3.1	31/09	12.2	NE	22.2	21/12	1011.5
91222	18.1N	145.8E	0724	25.9									
91251	11.4N	162.4E	0742	27.1					15.7	NE	28.9	21/19	1010.3
91343	7.6N	155.2E	0740	27.4					11.6	NE	20.4	24/09	1008.8
91353	6.2N	160.7E	0743	27.6					9.7	NE	20.8	30/08	1009.1
91365	8.9N	165.8E	0738	27.1					14.6	E	26.3	21/09	1009.4
91377	6.1N	172.1E	0744	27.4					7.6	NE	21.8	29/17	1007.6
ALSN6	40.5N	073.8W	0738	5.2	9.4	0.8	3.3	03/09	17.1	NW	45.7	15/02	1020.1
BURL1	28.9N	089.4W	0692	14.9					14.4	NE	31.9	20/09	1022.1
BUZM3	41.4N	071.0W	0744	4.0					18.4	W	41.4	21/15	1015.2
CARO3	43.3N	124.4W	0742	8.9					7.4	SE	27.2	18/14	1017.8
CHLV2	36.9N	075.7W	0743	9.4	11.1	1.0	2.6	19/13	16.9	SW	37.8	04/19	
CLKN7	34.6N	076.5W	0676	12.2					12.0	N	32.8	29/10	1023.2
CSBF1	29.7N	085.4W	0742	14.2					6.0	E	19.5	03/21	1023.0
DBLN6	42.5N	079.4W	0743	1.4					15.5	W	56.9	14/21	1019.0
DESW1	47.7N	124.5W	0743	8.2					14.3	E	40.6	12/20	1016.8
DISW3	47.1N	090.7W	0744	-4.6					14.1	SW	35.6	01/16	1018.7
DPIA1	30.3N	088.1W	0738	13.3	14.2				11.1	N	29.3	15/09	1023.3
DSLN7	35.2N	075.3W	0689	14.1		1.6	4.2	04/04	20.8	SW	46.5	03/23	1021.8
FBIS1	32.7N	079.9W	0743	12.2					8.9	NE	21.4	19/10	1023.0
FFIA2	57.3N	133.6W	0743	3.8					15.6	SE	38.2	01/03	1000.7
FPSN7	33.5N	077.6W	0743	15.5	19.6				17.1	N	35.2	04/01	1022.5
FWYF1	25.6N	080.1W	0743	22.9	24.1				13.8	E	36.6	20/06	1020.6
GBCL1	27.8N	093.1W	0730	19.6	23.0	1.4	3.7	20/07	16.5	SE	35.0	20/09	1021.4
GDIL1	29.3N	090.0W	0739	15.7	16.4				11.4	NE	27.3	15/00	1022.2
GLLN6	43.9N	076.5W	0743	-0.6					15.4	W	46.1	15/01	1018.6
IOSN3	43.0N	070.6W	0704	1.4					16.3	W	41.0	30/10	1017.2
KOSP2	5.4N	163.0E	0605	27.2					7.2	NE	21.6	31/11	1007.9
MDRM1	44.0N	068.1W	0742	0.2					19.0	NW	41.0	03/16	1016.5
MISM1	43.8N	068.9W	0676	0.3					18.7	NW	45.6	18/10	1017.0
MLRF1	25.0N	080.4W	0743	23.0	24.9				13.1	E	35.4	20/04	1020.0
MPCL1	29.4N	088.6W	0724	17.0	20.0	1.0	2.2	04/15	14.3	NE	35.1	20/07	1022.7
NWPO3	44.6N	124.1W	0741	8.1					8.6	E	33.1	05/22	
PILM4	48.2N	088.4W	0742	-4.8					16.4	SW	45.0	01/20	1016.6
PTAC1	39.0N	123.7W	0743	9.2					8.7	N	28.4	26/22	1018.2
PTAT2	27.8N	097.1W	0743	15.9	16.8				12.2	N	30.6	14/15	1020.1
PTGC1	34.6N	120.7W	0737	13.2					9.6	N	38.8	19/11	1016.9
ROAM4	47.9N	089.3W	0743	-4.8	3.3				18.1	SW	43.5	01/19	1017.8
SANF1	24.5N	081.9W	0742	22.7	24.5				13.9	NE	32.9	20/02	1019.8
SAUF1	29.9N	081.3W	0743	16.0	17.1				9.9	N	29.9	19/15	1022.3
SBIO1	41.6N	082.8W	0743	0.8					15.1	SW	44.1	14/20	1020.7
SGNW3	43.8N	087.7W	0742	-1.5					11.8	W	32.0	07/00	1019.8
SISW1	48.3N	122.9W	0742	7.5					13.0	SE	43.0	12/14	1016.2
SMKF1	24.6N	081.1W	0742	22.9	24.7				14.8	NE	38.7	20/01	1020.1
SPGF1	26.7N	079.0W	0744	22.1	24.7				8.4	E	27.2	20/04	1020.7
SRST2	29.7N	094.1W	0743	13.3					9.8	E	30.2	20/01	1021.7
STDM4	47.2N	087.2W	0744	-3.1					17.4	W	45.0	01/20	
TPLM2	38.9N	076.4W	0744	5.6	6.7				11.4	W	34.6	04/17	1021.3
TTIW1	48.4N	124.7W	0742	7.9					16.8	E	44.3	11/06	1016.3
VENF1	27.1N	082.5W	0743	17.9	19.2				7.2	NE	26.5	04/08	1021.5
WPOW1	47.7N	122.4W	0741	7.7					9.2	S	31.2	12/11	1017.0

Northwest England
Captain Albert Britain, PMO
Room 218,
Royal Liver Building
Liverpool L3 1HU
Tel: 051-236 6565 FAX: 051-227 4762

Scotland and Northern Ireland
Captain Stuart M. Norwell, PMO
Navy Buildings, Eldon St.
Greenock, Strathclyde
PA16 7SL
Tel: (0475) 24700 FAX: (0475) 892879

Bristol Channel
Captain Archie F. Ashton, PMO
Cardiff Weather Centre
Southgate House, Wood Street
Cardiff CF1 1EW
Tel: Cardiff(0222) 221423
FAX: (0222) 390435

Southwest England
Captain Douglas R. McWhan, PMO
Southampton Weather Centre
160 High Street
Southampton, SO1 0BT
Tel: Southampton (0703) 220632
FAX: (0703) 228846

Southeast England
Captain Clive R. Downes, PMO
Daneholes House, Hogg Lane
Grays, Essex
RM17 5QH
Tel: Grays Thurrock (0375) 378369
FAX: (0375) 379320

Northeast England
Captain John Steel, PMO
Room D418 Corporation House
73-75 Albert Road
Middlesbrough, Cleveland TS1 2RZ
Tel: Middlesbrough (0642) 231622
FAX: (0642) 242676

East England
Captain Edward J. O'Sullivan, PMO
C/O Department of Transport
Posterngate,Hull HU1 2JN
Tel: Hull (0482) 20158
FAX: (0482) 28957

Netherlands
Peter Schnitker, PMO
Aero. Met Division of KNMI
Rotterdam Airport
Tel: (010)- 437 0766

New Zealand
Ms. Julie Fletcher
Marine Meteorological Officer
New Zealand Met. Service
Tahi Rd., Box 1515
Paraparaumu Beach 6153
New Zealand Tel: (058) 73-237

Japan
Mr. I. Kawatsu, PMO
Yokohama Local Met. Observatory
Yamate-cho, Naka-ku
Yokohama, Japan
Tel: (045)-621-1991

Mr. M. Miyauchi
Japan Meteorological Agency
Otemachi, Chiyoda-ku
Tokyo, 100 Japan
Tel: (03)-212-8341

Hong Kong
Mr. Ip Sui Fui, PMO
134A Nathan Road, Kowloon
Hong Kong Tel: 732-9263

Germany
Mr. Henning Hesse, PMO
Wetterwarte, An der neuen Schleuse
Bremerhaven Tel: (0471) 72220

Mr. Jurgen Guehne, PMO
Seewetteramt
Bernhard Nocht-Strasse 76
Hamburg Tel: 040-319 0826

Kenya
Mr. Ali J. Mafimbo, PMO
PO Box 98512
Mombassa
Tel: (11) 25685 or 433440

Saudi Arabia
Mr. M. Murwani, PMO
National Meteorological Environment
Centre, Jeddah
Tel: (02) 683-4444 ext. 325

Singapore
Mr. Edmund Lee, PMO
Meteorological Service, PO Box 8
Singapore Changi Airport
Tel:5457198

France
Mr. Yanni Pringent, PMO
Station Meteorologique
Noveau Semaphore
Quai des Abeilles, Le Harve
Tel: 35.42.21.06

Mr. A. Rouzier
Station Meteorologique
de Marseille-Port
12 rue Sainte Cassien
13002 Marseille
Tel: 91.91.46.51, poste 336

South Africa
Mr. C. Sydney Marais, PMO
Roggebaai, Capetown, 8012
Tel: (021) 217543

Mr. Peter Rae, PMO
Meteorological Office
Louis Botha Airport, Durban 4029

Greece
Mr. George E. Kassimidis, PMO
Port Office, Piraeus
Tel: (01) 89-32914

Australia

Mr. Michael Hills, PMA
Pier 14, Victoria Dock
Melbourne, Vic. Tel: (03) 629 1810

Captain Alan H. Pickles, PMA
Stirling Marine
17 Mews Road
Fremantle, WA 6160
Tel: (09) 335 8444 Fax: (09) 335 3286.
Telex: 92821

Mr. E.E. (Taffy) Rowlands, PMA
NSW Regional Office
Bureau of Meteorology, 16th Floor
1580 George St.
Sydney, NSW 2000
Tel: (02) 269 8555

SEAS Field Representatives

Mr. Robert Decker
Seas Logistics/ PMC
7600 Sand Point Way N.E.
Seattle, WA 98102
206-526-4280
FAX: 206-526-6365
TELEX 7408535/BOBD

Mr. Steven Cook
SEAS Operations Manager
8604 La Jolla Shores Dr.
La Jolla, CA 92037
619-546-7103
FAX: 619-546-7003

Mr. Jim Farrington
SEAS Logistics/ A.M.C.
439 West York St.
Norfolk, VA 23510
804-441-3062
FAX: 804-441-6495

Mr. Robert Benway
National Marine Fisheries Service
28 Tazwell Dr.
Narragansett, RI 02882
401-782-6295

Mr. Warren Krug
Atlantic Oceanographic & Met. Lab.
4301 Rickenbacker Causeway
Miami, FL 33149
305-361-4433
FAX: 305-361-4582

Steve Ranne, Petty Officer USN
FLENUMOCEANCEN, Code 64
Monterey, CA 93943
408-647-4428
FAX: 408-647-4489

Atlantic Ports

Mr. Steve Fatjo, PMO
National Weather Service, NOAA
1600 Port Boulevard
Miami, FL 33132
305-358-6027

Mr. Lawrence Cain, PMO
National Weather Service, NOAA
Jacksonville International Airport
Box 18367
Jacksonville, FL 32229
904-741-4370

Mr. Earle Ray Brown, Jr., PMO
National Weather Service, NOAA
Norfolk International Airport
Norfolk, VA 23518
804-441-6326

Mr. James Saunders, PMO
National Weather Service, NOAA
Weather Service Office
BWI Airport
Baltimore, MD 21240
410-850-0529

Mr. Martin Bonk, PMO
National Weather Service, NOAA
Building 51
Newark International Airport
Newark, NJ 07114
201-624-8118

Mr. Dee Letterman, PMO
National Weather Service, NOAA
30 Rockefeller Plaza
New York, NY 10112
212-399-5569

Mr. Randy Sheppard, PMO
Atmospheric Environment Service
1496 Bedford Highway
Bedford, (Halifax) Nova Scotia B4A 1ES
902-426-6703

Mr. Denis Blanchard
Atmospheric Environment Service
100 Alexis Nihon Blvd., 3rd Floor
Ville St. Laurent, (Montreal) Quebec
H4M 2N6
514-283-6325

Mr. D. Miller, PMO
Atmospheric Environment Service
Bldg. 303, Pleasantville
P.O. Box 9490, Postal Station "B"
St. John's, Newfoundland A1A 2Y4
709-772-4798

Gulf of Mexico Ports

Mr. John Warrelmann, PMO
National Weather Service, NOAA
Int'l Airport, Moisant Field, Box 20026
New Orleans, LA 70141
504-589-4839

Mr. James Nelson, PMO
National Weather Service, NOAA
Houston Area Weather Office
1620 Gill Road
Dickinson, TX 77539
713-534-2640 (FTS731-2640)

Pacific Ports

PMO, W/PRx2
Pacific Region, NWS, NOAA
Prince Kuhio Fed. Bldg., Rm 411
P.O. Box 50027
Honolulu, HI 96850
808-541-1670

Mr. Robert Webster, PMO
National Weather Service, NOAA
501 West Ocean Blvd.
Room 4480
Long Beach, CA 90802-4213
310-980-4090
TELEX: 7402731/BOBW UC

Mr. Robert Novak, PMO
National Weather Service, NOAA
Coast Guard Island P.O. Box 5027
Alameda, CA 94501
510-273-6257 (FTS 536-6257)
TELEX: 7402795/WPMO UC

Mr. David Bakeman, PMO
National Weather Service, NOAA
7600 Sand Point Way, N.E.
BIN C15700
Seattle, WA 98115
206-526-6100

Mr. Bob McArter, PMO
Atmospheric Environment Service
700-1200 W. 73rd Av.
Vancouver, British Columbia
V69 6H9
604-664-9136

Mr. Lee Kelley, MIC
National Weather Service, NOAA
Box 37, USCG Base
Kodiak, AK 99619
907-487-2102/4338

Mr. Lynn Chrystal, OIC
National Weather Service, NOAA
Box 427
Valdez, AK 99686
907-835-4505

Marine Program Mgr. W/AR121x3
Alaska Region
National Weather Service
222 West 7th Avenue #23
Anchorage, AK 99513-7575
907-271-5121

Great Lakes Ports

Mr. Bob Collins, PMO
National Weather Service, NOAA
333 West University Dr.
Romeoville, IL 60441
815-834-0600

Mr. George Smith, PMO
National Weather Service, NOAA
Hopkins International Airport
Federal Facilities Bldg.
Cleveland, OH 44135
216-267-0069 (FTS 942-4949/4517)

Port Meteorological Officer
Atmospheric Environment Service
25 St. Clair Av. East
Toronto, Ontario
M4T 1M2
416-973-5809

Mr. Ronald Fordyce
National Water Research Institute
Port Meteorological Office
P.O. Box 5050
867 Lakeshore Rd.
Burlington, Ontario
L7R 4R6
416-336-6420 (FAX 416-336-4797)

FTS Now uses commercial no.

U.S. Headquarters

Mr. Vincent Zegowitz
Marine Obs. Program Leader
National Weather Service, NOAA
1325 East West Highway
Silver Spring, MD 20910
301-713-1724

Mr. Martin Baron
VOS Program Manager
National Weather Service, NOAA
Room 17345
1325 East West Highway
Silver Spring, MD 20910
301-713-1724

Richard DeAngelis, Editor
Mariners Weather Log, NODC
1825 Connecticut Av., NW
Washington, DC 20235
202-606-4561
Fax: 202-606-4586

United Kingdom Headquarters

Captain Gordon V. Mackie,
Marine Superintendent, BD (OM)
Meteorological Office Met O (OM)
Scott Building, Eastern Road
Bracknell, Berks RG12 2PW
Tel:(0344) 855654 Fax: (0344) 855921
Telex: 849801 WEABKA G

Australia Headquarters

Mr. A.D. Baxter, Headquarters
Bureau of Meteorology
Regional Office for Victoria, 26 floor
150 Lonsdale Street
Melbourne, Vic 3001`
Tel: (03) 669 4000

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data and Information Service
National Oceanographic Data Center
Washington, DC 20235

40

Address Correction Requested
OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

Book Rate

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328